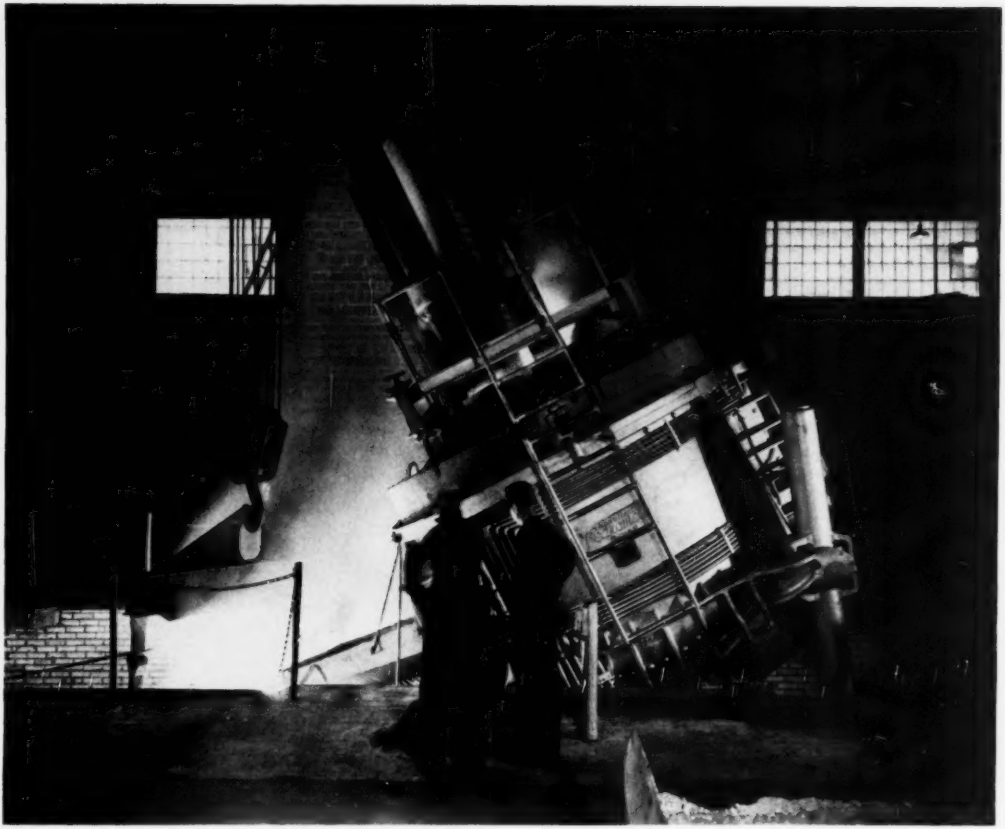
American Foundryman

OCTOBER
1949



A single heat of a Moore Rapid Lectromelt Furnace, like the Size OT pictured above, can provide the metal to fill a variety of small orders. Because in Lectromelt furnaces you can readily change the analysis of the metal to take care of a number of orders of varying analyses. You simply tap the metal to fill the first order, change the analysis, tap to fill the second order, and continue that procedure until all your orders are filled.

Lectromelt furnaces are available in sizes ranging from 100 tons to 250 pounds. Write today for your copy of the Lectromelt catalog which gives you full details.

PITTSBURGH LECTROMELT FURNACE CORPORATION
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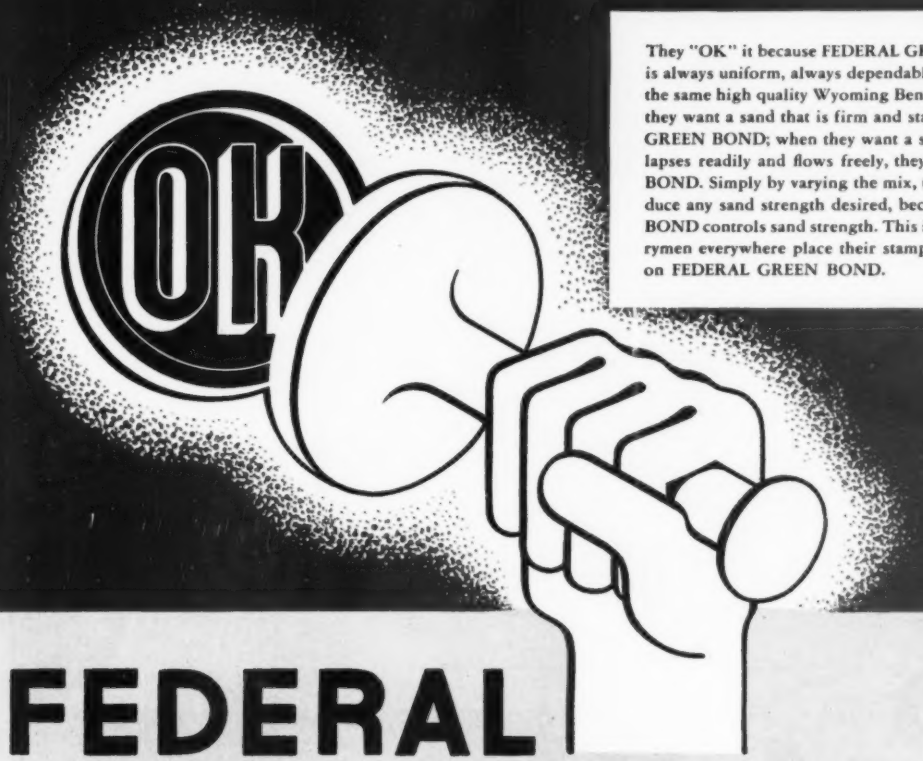

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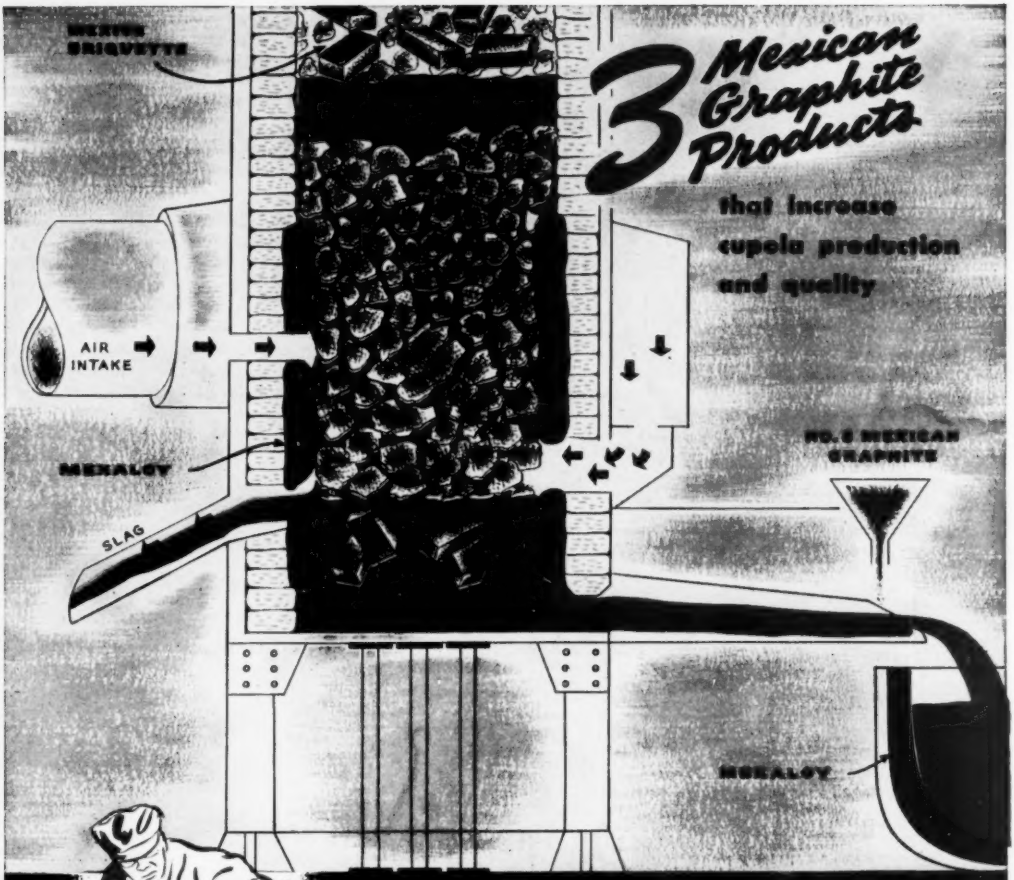

3 Mexican Graphite Products

that increase cupola production and quality

MEXITE BRIQUETTES. One 4-lb. Mexite Briquette provides the same carbon content as 50 lbs. of pig iron when introduced into the cupola charge. Not only do Mexite briquettes sharply reduce melting costs per ton; they also reduce the range of carbon content fluctuation and give a steadier carbon analysis, a particularly vital factor when high percentages of steel are charged.

MEXALOY, applied to cupola linings, ladles, and spouts, resists molten metal and slag and keeps metal free from refractory inclusions. Its natural lubricating action provides low friction surfaces which part easily from metal and slag. A Mexaloy mixture is easily applied to any clean surface. Because it will not melt or change character under intense heat, Mexaloy gives longer refractory life with lower maintenance cost.

NO. 8 MEXICAN GRAPHITE is used for ladle additions to treat grey cast iron. Trickled into the cupola spout as metal falls into the ladle or with a direct ladle addition, it greatly reduces chill and hardness, producing castings of increased machineability. Normally only 2 lbs. of No. 8 need be added per ton of molten metal—a cost of only ten cents per ton—to assure castings which require no annealing. Write today for complete information on how Mexite Briquettes, Mexaloy, and No. 8 Mexican Graphite will give you better castings for less money.

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OCTOBER, 1949

VOLUME XVI, NUMBER 4

American Foundryman

October, 1949

Official publication of American Foundrymen's Society

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Announce Programs for More Regional Foundry Conferences

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Modern Foundry Methods

The Round Table

Trends in Aluminum Casting Alloys: Walter Bonsack

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Patching the Cupola—Develop Air-Placement Process: N. J. Dunbeck and T. E. Barlow

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AMERICAN FOUNDRYMAN is indexed regularly by Engineering Index, Inc.

This Month's Cover

Making cores for steel castings to be used on heavy equipment are two floor coremakers of Minneapolis Electric Steel Castings Co., Minneapolis. In the foreground a core section for a 58 in. roller path and ring gear used in shovels, draglines, and other earth moving machinery is being rammed. Core being made in the background will help produce a locomotive cylinder head.

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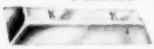

STEEL PLANTS

60 lb. Keokuk Electro-Silvery pigs are used by many leading steel plants for blocking the open hearth heat. They produce excellent results for an equal distribution of silicon and for the best temperature melt-down.

FOUNDRIES

10 lb. Keokuk Electro-Silvery pigs are charged into the cupola by mechanical means or by hand. Easily broken into two or more pieces and measured by weight. 12½ lb. Keokuk Electro-Silvery piglets may be charged by count, eliminating weighing operations. Both sizes are available in regular or alloy analysis.

All three sizes may be handled by magnet!

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SALES AGENTS: Miller and Company, 332 S. Michigan Ave., Chicago 4, Illinois
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GOOD NEWS for Foundrymen!

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No. 5-6—Same as No. 5-5 above, but with 6 cu. ft. capacity, for coal and coke. 14 gauge tray.

Sterling Foundry Wheelbarrows Available for Prompt Shipment

Now — you can solve your foundry hauling problem with Sterling Tubular Steel Handled Wheelbarrows. The same dependable manufacturer who supplies you with Steel Foundry Flasks is now in position to take care of all your wheelbarrow requirements. Select any type . . . any size . . . Sterlings will fill the bill. They have long been known for their labor saving qualities and ability to withstand rough foundry usage. The all-welded Sterling tray is lapped at corners for double strength and is equipped with a continuous steel, butt-welded reinforcing rod around the top edge. Write for catalog giving detailed specifications.

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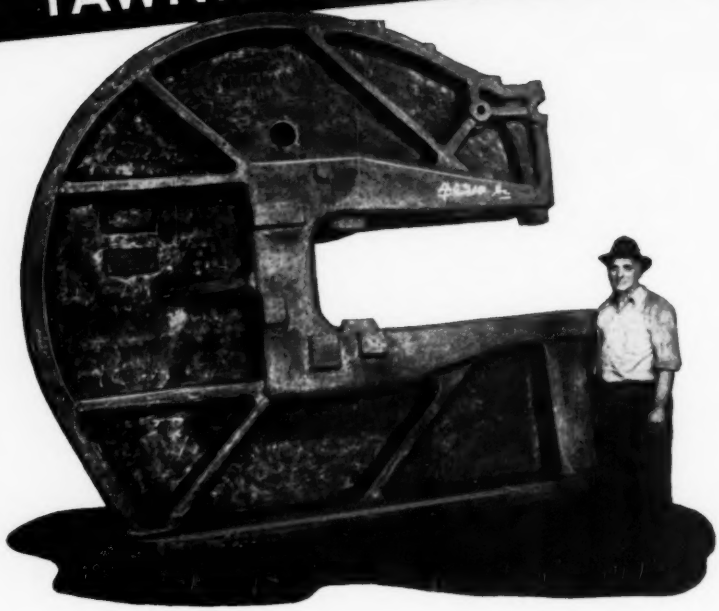
they cure "YAWNING" on the job...

. . . with NICKEL CAST IRON



"Yawn" or "give" in a cast machine part often spells rejects for the machine user.

No ordinary cast iron solves this problem, because the low elastic modulus of unalloyed iron under heavy stresses frequently permits dimensional changes.

But..."give" can be reduced to a negligible minimum.

In the 20-ton casting shown above, produced by Schneider Bowman Company, Inc., Philadelphia, Pa., for a large punch press made by Wiedemann Machine Company of Philadelphia..."give" was minimized by casting this part in iron containing 1.50 percent Nickel.

Developing 45,000 pounds per square inch tensile strength in heavy sections, this casting exemplifies the high elastic modulus and strength obtainable with Nickel cast iron.

Hundreds of foundries now use Nickel cast iron to secure these basic advantages:

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Nickel aids the progressive foundry to meet high mechanical property specifications.

IN THE MACHINE SHOP—
Nickel cast irons provide strong, readily machinable castings that take a smooth finish.

IN SERVICE LIFE—
Nickel cast irons assure long, trouble-free performance for the ultimate user.

Don't Forget...

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Jot down—"INCO Booth, No. 302" —in your memo book of companies to visit at the **NATIONAL METAL EXPOSITION,** at the Public Auditorium in Cleveland, Ohio, October 17th to 21st. Convenient facilities for discussing your problems with our metallurgists and foundry specialists will be available.

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For More Than Half a Century

Most Valuable to Foundrymen for the Production of Highest Quality Castings

JUST as a diamond, which in its rough state is a crystalline form of pure carbon, must be cut, polished and faceted to produce a flawless stone, another crude form of pure crystalline carbon known as Ceylon (East India) Graphite, must be ground, processed and blended into specific grades of Stevens Plumbago to help you produce flawless castings.

If the nature of your work demands that you turn out flawless castings of finest finish, by all means don't overlook the Stevens Ceylon (East India) Plumbago collection of mold facings. You'll find each a "gem" in its own right.

Most prized of all, is a grade known as No. 90 (containing 90% or more pure graphitic carbon) having extremely high heat resistant qualities. Under the most severe conditions involving metal temperature and casting section thickness, it produces an unbelievably smooth, beautiful casting finish with excellent color.

In addition, there are other fine quality grades of Stevens Plumbago based on the incomparable Ceylon (East India) Graphite. These are blends of several graphites having specific characteristics which meet *every* mold facing requirement—for either dry or wet application.

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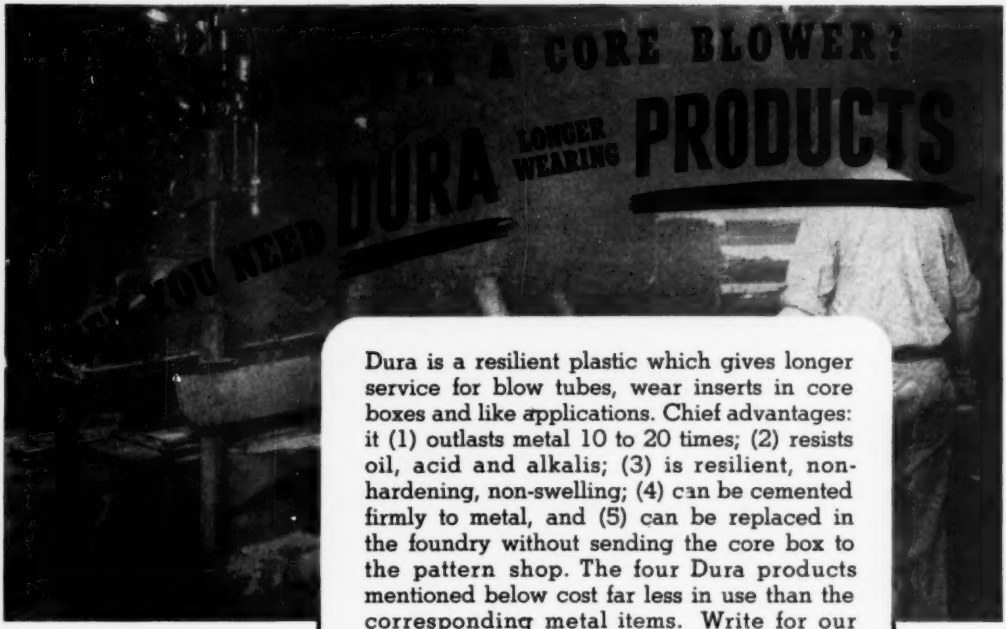

Dura is a resilient plastic which gives longer service for blow tubes, wear inserts in core boxes and like applications. Chief advantages: it (1) outlasts metal 10 to 20 times; (2) resists oil, acid and alkalis; (3) is resilient, non-hardening, non-swelling; (4) can be cemented firmly to metal, and (5) can be replaced in the foundry without sending the core box to the pattern shop. The four Dura products mentioned below cost far less in use than the corresponding metal items. Write for our well illustrated 8-page Bulletin "A".

DURATUBES

Duratubes **pinch off sand tips,** eliminating distortion and hand filing of complex cores; cut production losses in the changing of bushings; seal effectively against air leakage between box and blow plate. They often cost less to buy than special metal tubes; they regularly stand up 10-20 times as long.

DURABUTTON

Durabutton is a plastic wear insert for core boxes which lowers replacement time and increases production; reduces wear on core boxes around wear inserts; sometimes makes fewer core boxes necessary; regularly lasts 10-20 times as long as metal inserts; quickly changed. Furnished with or without bolt.

DURASTRIP

Durastrip is a resilient, plastic sheet from which wear strips for core boxes or wear inserts of any shape can be cut readily. Its perfect fit forms a reliable air seal between box and blow plate, eliminating leakage and resultant wear; it is easily and quickly cemented into place; outwears metal 10-20 times.

DURAROD

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Toss a little Famous Cornell Cupola Flux into cupola with each ton charge of iron and get --

- Clean metal
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- Sulphur reduction
- Sounder castings
- Tougher castings
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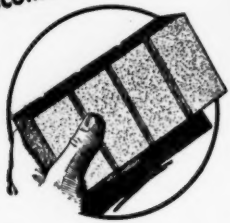
- Easier machining
- Cleaner cupolas

Total

- Reduced casting rejects
- Reduced cupola maintenance
- Better casting deliveries
- Increased prestige

Famous CORNELL CUPOLA FLUX

IN SCORED BRICK FORM



Flux in this pre-measured scored brick form reduces, to a few seconds, the time required for cleansing molten iron. No digging out of container. No weighing. No measuring. Simply toss Famous Cornell Flux into cupola with each ton charge of iron or break off one to three briquettes (quarter sections) for smaller charges.

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for the Asking . . .

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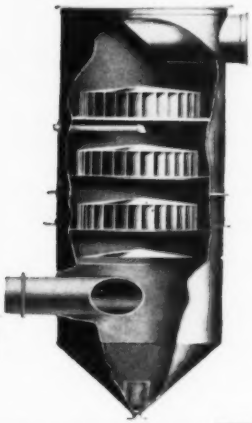
A general bulletin containing detailed information on all Schneible Foundry Ventilation and Dust Control Equipment. Ask for bulletin No. 47

Schneible Multi-wash Collectors, Dewatering Tanks and Pumps are detailed in this bulletin. Ask for bulletin No. 410

Specific information on Schneible Water Curtain type Cupola Collectors for melting department operation. Ask for bulletin No. 449



MULTI-Wash COLLECTORS
Model HC—1500 to 30,000 c.f.m. or multiple units for larger capacities.
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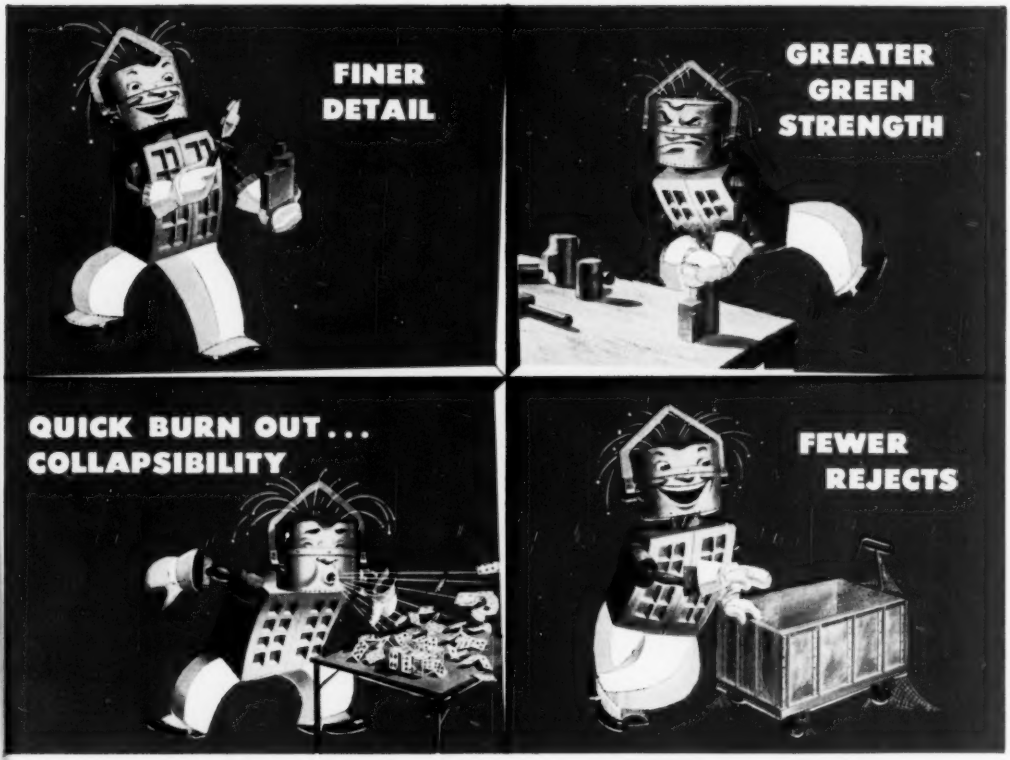
WHAT EVERY CORE-MAKER NEEDS AND WANTS:



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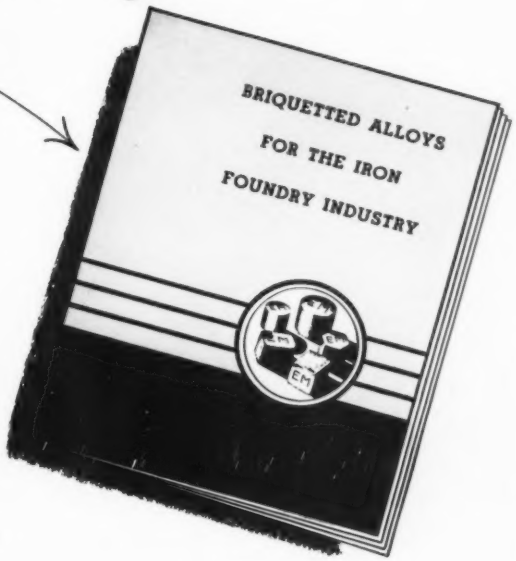

This new booklet describes in detail:

- How ferro-alloys control the composition of iron and compensate for variations in raw materials.
- The beneficial effects of silicon, manganese, and chromium in cast iron.
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- How to calculate the number of briquets to add to the charge.
- How to control carbon, sulphur, and phosphorus.
- Typical cupola charges for soft gray iron, high-strength iron, and low-chromium iron.

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TO CONTROL CARBON, SULPHUR AND PHOSPHORUS
METHOD OF CALCULATING BRIQUET CHARGES

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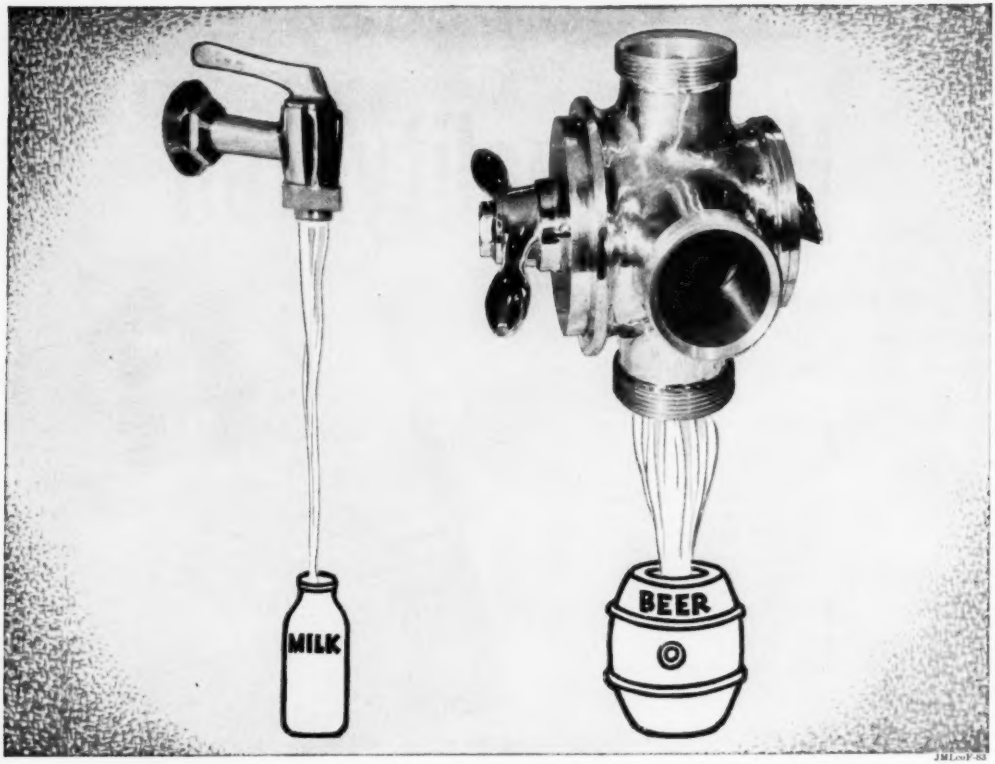

PERFECT METAL–PERFECT CASTINGS!

The small valve is for the dairy industry; the large one for the brewery field. Both are cast of Federated Nickel Silver . . . for very good reason.

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Nickel silver alloys are particularly suited for use where high corrosion resistance and silvery white color are important. Federated metallurgists can tell you exactly what alloy fits your need. They are ready and willing to help out in your foundry, too, should casting problems arise.

For nickel silvers; brasses and bronzes; aluminum and magnesium alloys; solders; babbitts; fabricated lead products; for any non-ferrous metals, see Federated first.

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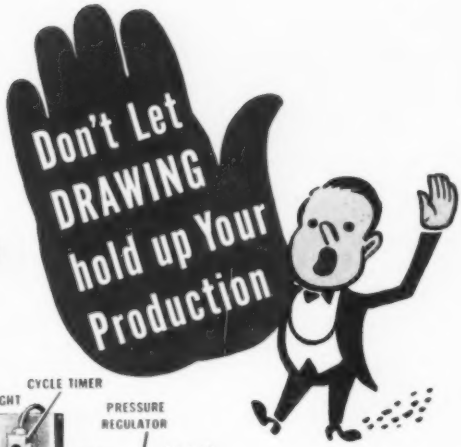
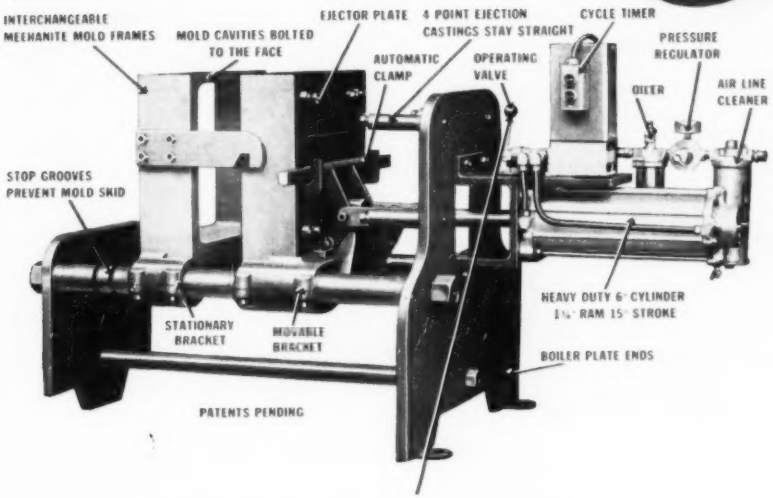
Federated METALS DIVISION

AMERICAN SMELTING AND REFINING COMPANY, 120 BROADWAY, NEW YORK 5, N. Y.

MASTER PNEUMATIC DRAW TABLE

for Aluminum Permanent Molds





Open, Close, Clamp & Eject Casting with ONE LEVER!

The perfected, foolproof Master Pneumatic Draw Table—so simple to operate that ONE man can easily work TWO machines . . . and places permanent mold castings on a real quantity production basis! Push one lever and the cavity blocks meet—no clamps to tighten, no further adjustment necessary.

Pour the metal and the automatic timer takes over —releases the cavity blocks and ejects the casting with no attention from the operator.

This Pneumatic Draw Table is now offered at a price that makes even the simplest draw table you produce yourself a pure luxury. Write now for information and prices!

MASTER PATTERN COMPANY

1317 MAIN AVENUE — CLEVELAND 13, OHIO

DESIGNERS AND MANUFACTURERS OF PERMANENT MOLDS, WOOD AND METAL PATTERNS AND MODELS

WHY KEEP ON PAYING FOR SCRAPPED CASTINGS?

The figures here (look at them) are typical of operating records of foundries which have no dependable sand control procedure. These figures show exactly what to expect when SAND MOISTURE is TOO HIGH or TOO LOW. The same holds true for PERMEABILITY and STRENGTH.

Keep these critical factors under control and your scrap losses will drop way down immediately. This isn't just theory. You can see it for yourself by visiting any foundry where Dietert-Detroit sand control is being used.

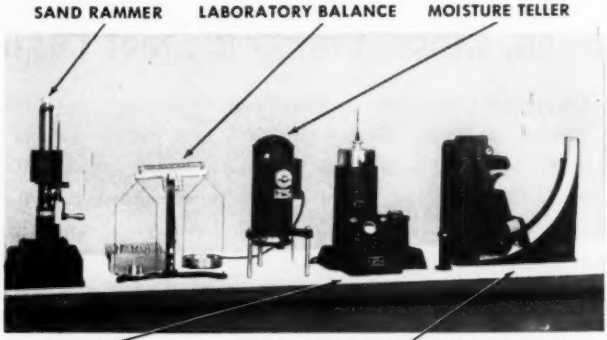
SAND CONDITIONS AND SCRAP LOSSES

	Date	Per Cent Moisture	Permeability	Green Strength PSI	Dry Strength PSI	SCRAP LOSS	Trouble
Floor "A"	Apr. 4	**4.6 OK**	71	7.2	69	**1.1% OK**	—
	Apr. 5	**7.5 TOO HIGH**	63	6.7	85	**16.7% BAD**	Blows Scabs
	Apr. 6	**3.5 TOO LOW**	82	8.1	56	**7.3% BAD**	Dirt
Floor "B"	Aug. 4	4.7	**70 OK**	7.0	72	**.9% OK**	—
	Aug. 8	4.5	**35 TOO LOW**	8.2	90	**12.6% BAD**	Blow—Misrun
	Aug. 12	4.7	**110 TOO HIGH**	6.5	62	**5.7% BAD**	Penetration
Floor "C"	June 15	4.6	75	**7.2 OK**	68	**.7% OK**	—
	June 16	4.4	82	**4.2 TOO LOW**	58	**15.2% BAD**	Drops—Dirt
	June 20	4.6	60	**11.6 TOO HIGH**	88	**5.6% BAD**	Rough
Floor "D"	July 11	4.7	73	7.6	**73 OK**	**1.0% OK**	—
	July 13	4.8	79	6.5	**15 TOO LOW**	**7.9% BAD**	Cut—Wash
	July 14	4.9	65	8.2	**167 TOO HIGH**	**11.8% BAD**	Scabs

HERE'S HOW YOU CAN DO IT *IN YOUR FOUNDRY*

The only new equipment you need is that shown in the illustration. It is all standard foundry equipment, easy to operate and doesn't cost much—$618.85 covers everything. The SAVING you make in the first few months will more than pay back the initial investment. We'll be glad to give you full particulars if you write to us.

5392



HARRY W. Dietert COMPANY

CONTROL EQUIPMENT
SAND · MOLD · MOISTURE
CARBON · SULFUR

9330 ROSELAWN AVE. • DETROIT 4, MICHIGAN

A BULL'S-EYE the first time and every time with

UNIVERSAL FLASK PINS and BUSHINGS for cope and drag

Cope and drag alignment troubles are a thing of the past once you install Universal precision made standardized Flask Pins and Bushings. When Universal closing pins are used, *valuable production time is saved on each operation* because Cope Bushings are quickly guided to the Drag Pins. Universal Flask Pins and Bushings are hardened and ground for *maximum resistance to wear,* adding greatly to their productive life. Design permits longitudinal expansion to compensate for metal heat, without affecting accurate alignment. Universal Flask Pins and Bushings are made in standard sizes and shapes. Special types and sizes to order. *Write for illustrated folder.*

UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 12, MICHIGAN

THE USE OF AJAX PHOSPHOR-COPPER

Send for booklet
"INGOT METALS OF TODAY"

●

15 STANDARD ALLOYS BY AJAX

Ajax Tombasil
Ajax Plastic Bronze
Ajax Anti-Acid Bronze
Ajax Phosphor Bronze
Ajax Red Brass Ingots
Ajax Manganese Bronze
Ajax High-Tensile Manganese Bronze
Ajax Golden Glow Yellow Brass
Ajax Nickel-Copper 50-50%
Ajax Manganese Copper
Ajax Aluminum Alloys
Ajax Phosphor Copper
Ajax Silicon Copper
Ajax Nickel Alloys
Ajax Phosphor Tin

NOTE

"Proper Melting Decreases Foundry Losses," contains interesting data. Also, the booklet, "Nonferrous Ingot Metals of Today." Write for both of these. They are free.

Successful foundrymen deoxidize or "clean up" molten metal by a scientific method worth using *as indicated:*

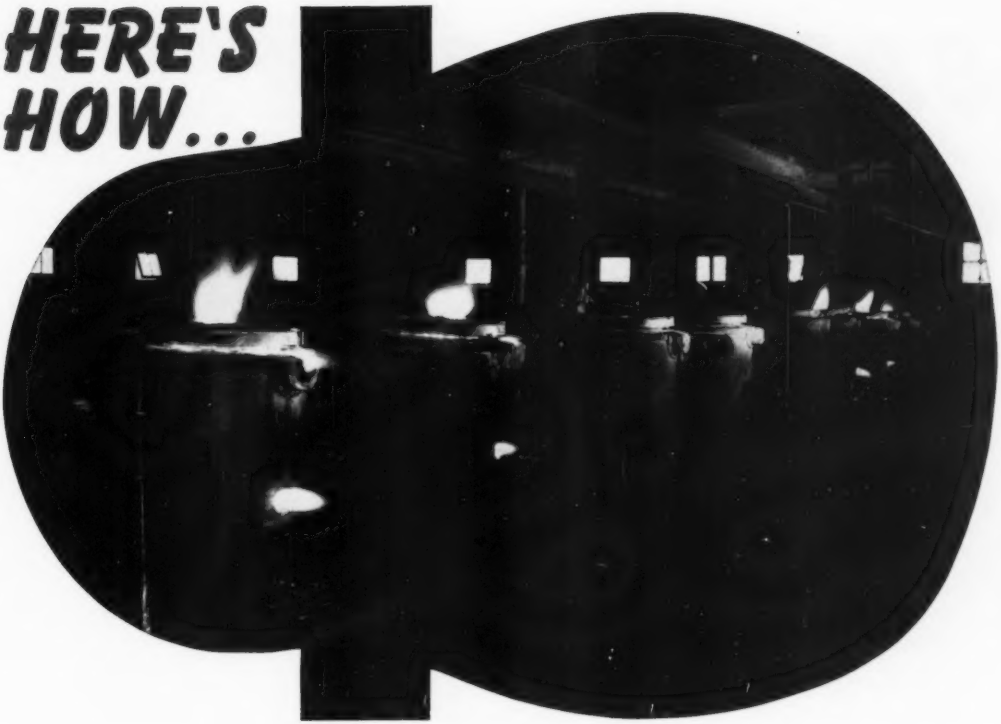
They use phosphorus . . expertly . . in the form of "Ajax Phosphor Copper" . . added as the crucible is removed from the furnace . . for virtually all brass and bronze alloys.

In notched waffle sections, or in shot form, Ajax 15% P-Cu does its work at .01% (1 oz. per 100 lbs.). Introduced, and having time to react when stirred with a whirling motion of the skimmer, it causes oxides to rise for effective removal by skimming from the surface. It is best to avoid phosphorus build-up from back stock.* . . If you use phosphorus these days, use Ajax Phosphor Copper (useful also in producing your phosphor bronze)

THE **AJAX** METAL COMPANY
ESTABLISHED 1880 PHILADELPHIA

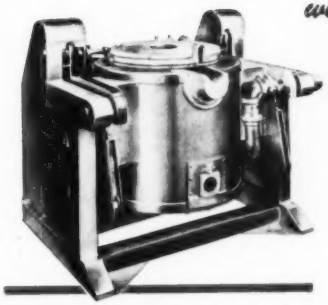
ASSOCIATE COMPANIES:
AJAX ELECTRIC FURNACE CORPORATION, *Ajax-Wyatt Induction Furnaces for Melting*
AJAX ELECTROTHERMIC CORPORATION, *Ajax-Northrup Induction Furnaces for Melting, Heating*
AJAX ELECTRIC COMPANY, INC., *Electric Salt Bath Furnaces*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Furnaces*

HERE'S HOW...



LINDBERG-FISHER TILTING FURNACES DOUBLE PRODUCTION....

with half as many furnaces - at 39% lower fuel cost!



See your Lindberg-Fisher man for full details, or write for Bulletin No. 57-A.

Hammond Brass Works, Hammond, Indiana, manufacturers of fine bronze, valves and fittings, recently installed 6 Lindberg-Fisher constant-arc nose pouring, gas fired, tilting furnaces for their melting and pouring operations. They have operated these furnaces for more than 6 months, 8 hours a day, 5 days a week. Their experiences show greatly increased production, reduced production costs, with safer and cleaner operating conditions.

Hammond Brass Works reports that small, obsolete furnaces were replaced with half as many large, modern Lindberg-Fisher mechanized tilting furnaces. The number of necessary heats per day was reduced one-third while double the quantity of molten metal was handled. Fuel consumption per lb. of metal was reduced 39%, labor cost per operation was lowered and crucible life increased from 65-70 heats to an average of 95-100 and up to 200 heats per crucible. Clean-up time has been reduced and maintenance problems simplified—resulting in a safer, cleaner operation, and raised employee morale.

Fisher Furnaces

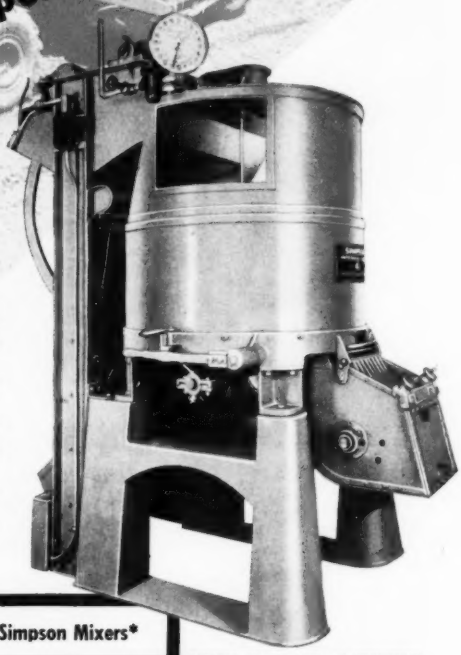
A DIVISION OF LINDBERG ENGINEERING CO.

2440 West Hubbard Street, Chicago 12, Illinois

GREATER CAPACITY

in TONS

per batch...
per hour...
per day...



When it comes to turning out more tons of properly conditioned and cooled sand, with resulting high mold capacity per working day, you just can't beat the high efficiency of SIMPSON MIXERS. Yet with this high productive capacity, you actually require fewer mixing cycles per hour, because of the large batch capacity of the mixers. Thus, with greater capacity and fewer mixing cycles, you have ample time to take frequent sand samples, to accurately determine and improve sand quality for a net result of more good castings at lower cost.

** Rated batch capacities of SIMPSON MIXERS are not theoretical figures . . . they are proved on the job in hundreds of large and small foundries all over the world. Ask to have a National Engineer show you how to increase production, improve quality and lower cost.*

Batch Capacities of Simpson Mixers*

No. 3½ Mixer	5000 lbs.
No. 3 Mixer	3000 lbs.
No. 2 Mixer	1500 lbs.
No. 1½ Mixer	700 lbs.
No. 1H Mixer	400 lbs.

**Based on actual practice in hundreds of foundries.*

ABOVE: Typical No. 2 SIMPSON MIXER unit, with NATIONAL Bucket Loader, Aerator and Water Meter. LEFT: No. 3 SIMPSON MIXER preparing backing and facing sands in foundry of a large machine tool manufacturer.

SIMPSON Intensive MIXERS

NATIONAL *Engineering Company*

600 Machinery Hall Bldg. • Chicago 6, Illinois

Manufacturers and Selling Agents for Continental European Countries—The George Fischer Steel & Iron Works, Schaffhausen, Switzerland. For the British Possessions, Excluding Canada and Australia—August's Limited, Halifax, England. For Canada—Dominion Engineering Co., Ltd., Montreal, Canada. For Australia and New Zealand—Gibson, Battle & Co., Pty., Ltd. Sydney, Australia

FEF OBJECTIVES FULFILL INDUSTRY NEED

NUMBER ONE objective during the formative days of the Foundry Educational Foundation two and one-half years ago was to foster and improve education in United States colleges and universities in the field of foundry engineering, practice, and operation. We felt we could increase greatly the prestige of the foundry industry and believed the program would attract to the foundries more young men with basic education in keeping with the requirements of our business. We knew our industry also would benefit when engineers who have gone through this foundry program entered the service of present or potential customers for castings.

Today the Foundation is operating in seven schools and is planning on five more for the expanded program to begin May 1, 1950. In two years we have seen a change from a condition requiring us to solicit the cooperation of schools to where they have seen our accomplishments and now are seeking our cooperation.

A total of 102 students have shared in the 148 scholarship units made available to FEF universities to date. (A unit is equivalent to an award for one college year.) In addition, 117 students have elected to follow the FEF program on a voluntary basis.

Even with reduced business activity, foundry operators gave 122 engineering students an opportunity to gain further experience through summer work and added 74 engineering graduates in anticipation of future needs. As a result, our industry—in comparison to business as a whole—will show a creditable absorption of these young men.

The Foundation has received many compliments from engineering societies, educational institutions, and members of our industry, with practically no criticism although we solicit it. We quote from a letter written by an important educator in one of the large technical schools:

"The efforts of the Foundry Educational Foundation in promoting summer jobs in the foundry industry provides an invaluable service in interesting students, and one which none of the other technical societies or trade organizations have as yet attempted. All too few industries do such valuable work on an organized basis . . . We think the whole plan is well conceived."

The progress made in the past two years has exceeded the best expectations of those who labored to get the Foundation under way, and we feel that in that short period much has been accomplished toward establishing at the higher educational institutions the proper prestige of our important industry. In these two years the Foundation has adhered strictly to its original objectives, avoiding overlapping any activity of any existing organization. We propose to hold to this program in the future. By following this plan the Trustees have been able to intensify the activity of the Foundation without any addition to the operating personnel and to keep within its original budget.

The FEF program is financed through the first three-year cycle ending May 1950. It is necessary to plan several years in advance so that cooperating schools may set up their programs for a period longer than one year. So that the Trustees may lay the future course intelligently, there will be a fund raising campaign this fall to finance the next three-year cycle ending in 1953.

It is the general feeling that the industry fully appreciates the value of the Foundry Educational Foundation program and will respond accordingly.

Stowell C. Wasson

STOWELL C. WASSON
President
FOUNDRY EDUCATIONAL FOUNDATION

This year's president of the two-year old Foundry Educational Foundation, Stowell C. Wasson, has just completed a term as a National Director of the American Foundrymen's Society. Manager of the Cicero and Melrose Park (Ill.) Works of National Malleable & Steel Castings Co., he is one of the organizers of the Central Indiana Chapter and has long been interested in the training of young engineers and technicians. Participating in FEF activities from their inception, Mr. Wasson became a trustee when the Foundation was incorporated early in 1947 and was elected president at the organization's annual meeting this year.

PLAN EXHIBITS AND TECHNICAL PROGRAMS FOR '50 CONVENTION

PROSPECTIVE EXHIBITORS at the 1950 A.F.S. Foundry Congress and Show, to be held May 8-12, 1950, in Cleveland's Municipal Auditorium, have received a first mailing urging them to make allowances in their 1950 budgets for participation in the Convention Exhibit. Some exhibitors have already visited Cleveland Auditorium to select suitable locations for their equipment, and cooperative arrangements have been made by several manufacturers to arrange facilities for carrying out a complete foundry operation.

Exhibits Committee Meets

Exhibit arrangements recently received added impetus through two meetings of the A.F.S. Exhibits Committee, composed of several of the nation's leading manufacturers of foundry equipment and supplies. At meetings July 15 in Cleveland and August 12 in Chicago, the Committee reviewed rules and regulations for the 1950 Exhibit, and learned that the A.F.S. Board had approved holding the next Exhibit in the spring of 1952. (EDITOR'S NOTE: Unofficial word from the 1949 International Foundry Congress recently held in Amsterdam, Netherlands, indicates that the 1952 A.F.S. Annual Convention and Foundry Show will be an International Foundry Congress. Second International was held in conjunction with the 1926 A.F.S. Foundry Congress in Detroit, and the Fifth International Congress convened in 1934 at Philadelphia where A.F.S. met that year. Expected to be held in the United States again in 1942, an international meeting was not possible because of war and the A.F.S. Annual Convention and Foundry Show in Cleveland that year was designated Western Hemisphere Foundry Congress.

Technical Sessions Planned

Plans for technical sessions of the 1950 Convention have been under way since early this summer, when Program and Papers Committees of the various divisions and general interest committees held a series of meetings to make tentative plans and schedule presentation of papers, a number of which are already in the hands of the committees. Authors wishing to offer technical papers for the 1950 Convention are requested to submit them to S. C. Massari, Technical Director, American Foundrymen's Society, 222 W. Adams St., Chicago 6, Ill. not later than December 15 for transmittal to appropriate committees.

On schedule for the Gray Iron Division are a Round Table Luncheon (new last year) a symposium on the production of nodular graphite cast iron to be sponsored jointly with the Malleable Division, three Shop Course sessions and several technical meetings.

Sponsored jointly by A.F.S. and the American Society for Testing Materials will be a symposium on centrifugal casting. Topics will relate to the properties of centrifugally cast metals.

Tentative plans of the Time Study and Methods Committee call for a session on development of bench coremaking standards and a joint meeting with the Cost Committee for the presentation of papers showing the coordination between standards and cost departments for maximum service to management. Refractories Committee sessions are expected to be expanded in 1950 to provide meetings of specific interest to the several branches of the foundry industry.

Malleable Division plans announced to date include a paper sponsored by the Controlled Atmosphere Annealing Committee to be prepared by three authors. These men, who have different types of annealing equipment in their plants, are planning to compile comprehensive information on the effects of atmospheres on malleable iron castings in various furnaces.

Plan Two Educational Sessions

Cleaning room equipment will be discussed at the Convention session sponsored by the Plant and Plant Equipment Committee. Recommendations of the Educational Division are that at least two sessions should be held at next year's Foundry Congress and Show. These should relate to (1) the college level, and (2) the trade and high school level and/or training within industry.

Early interest in the 1950 A.F.S. Apprentice Contest whose first-prize winners will be awarded $100 checks

Milwaukee Vocational School shops will again be the site of the pattern competition in Wisconsin Chapter's Apprentice Contest, to be held in preparation for the 1950 A.F.S. National Apprentice Contest. Last year saw a record number of entries in the local contest.

by A.F.S. National President Edwin W. Horlebein at the Convention—indicates that the 1950 Contest will be the largest in the history of the Society. The A.F.S. Wisconsin, Detroit, Northern Illinois-Southern Wisconsin, and Southern California Chapters have already laid preliminary plans to participate in the Contest. Regulations governing the Contest have been sent to all A.F.S. Company and Sustaining members, past participants and Educational Committee chairmen of the 40 Chapters of the Society.

Apprentice Contest Now Open

Now in its 27th year, the Contest opened September 15, and will continue until early in April, when the National Judging will take place. Some plants, as well as chapters, will conduct local contests to select entries for the final competition. Lone contestants will be entered by their firms directly in the final judging, to be held this spring.

Prizes awarded in each division of the Contest are $100, $50, and $25. All winners receive certificates of recognition and first place winners have round trip rail and Pullman fare provided by A.F.S. so they can attend the 53rd A.F.S. Convention in Cleveland, May 8-12.

Add Fifth Contest Division

A fifth Contest division—Metal Patternmaking—has been added this year to the four which have been standard for some time—Gray Iron Molding, Steel Molding, Non-Ferrous Molding, and Wood Patternmaking. Any apprentice is eligible to enter the competition provided he is taking a regular training course of not less than three years duration and is not over 24 years old on the day he makes his pattern or mold. For veterans the age limit is 24 plus their length of service in the armed forces.

Patterns for the molding divisions and blueprints for wood patternmaking are supplied through A.F.S. Headquarters. For metal patternmaking, blueprint and rough aluminum castings will be supplied. Regulations and additional information on the 1950 A.F.S. Apprentice Contest can be obtained from Jos. E. Foster, Technical Assistant, American Foundrymen's Society, 222 West Adams St., Chicago 6, Ill.

A.F.S. Exhibits Committee Studies Policies, Regulations For 1950 Show

PLANS AND POLICIES for the 1950 A.F.S. Foundry Show, to be held in conjunction with the Society's Annual Convention, Cleveland, May 8-12, 1950, have been reviewed by the A.F.S. Exhibits Committee, meeting in Cleveland, July 15, and Chicago, August 12. At the second meeting, it was announced by Past President W. B. Wallis, presiding, that the A.F.S. Board of Directors had approved holding an Exhibit (next after 1950) in the spring of 1952.

Present at the meeting in addition to Mr. Wallis were President Edwin W. Horlebein, Secretary-Treasurer Wm. W. Maloney, Convention and Exhibits Manager A. A. Hilbron, and the following:

L. L. Andrus, American Wheelabrator & Equipment Co., Mishawaka, Ind.; Warner Bishop, Werner G. Smith Co., Cleveland; H. T. Bourne, C. O. Bartlett & Snow Co., Cleveland; W. J. Cluff, Frederic B. Stevens, Inc., Detroit; G. B. Comfort, Schramm, Inc., West Chester, Pa.; N. J. Dunbeck, Eastern Clay Products, Inc., Jackson, Ohio; Stevens H. Hammond, Whiting Corp., Harvey, Ill.; L. H. Heyl, Federal Foundry Supply Co., Cleveland; R. G. Kaveny, Herman Pneumatic Machine Co., Pittsburgh; E. H. King, Hill & Griffith Co., Cincinnati; R. L. McIlvaine, National Engineering Co., Chicago; C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Co., Chicago; L. D. Pridmore, International Molding Machine Co., La-Grange, Ill.; William Romanoff, H. Kramer & Co., Chicago; Claude B. Schneible, Claude B. Schneible Co., Detroit; V. F. Stine, Pangborn Corp., Hagerstown, Md.; and C. H. Wantz, General Electric X-Ray Corp., Milwaukee.

Approve Convention Registration Fee

Reporting further on A.F.S. Board actions, Mr. Wallis stated that the Exhibits Committee recommendation on registration fees had been approved. Consideration had been given to the suggestion that Cleveland be designated the permanent site for A.F.S. Exhibits but no action was taken, he said. The Exhibits Committee discussed the merits of various convention and exhibits cities.

C. V. Nass, speaking for the Foundry Equipment Manufacturers' Association, said he desired to express appreciation of FEMA for the consideration given the Exhibits Committee and exhibitors' recommendations, in the interest of furthering cooperation between A.F.S. and exhibitors. Mr. Nass's motion was seconded by L. H. Heyl, representing the Foundry Facings Manufacturers' Group, and was carried unanimously.

Central Pennsylvania Foundrymen Planning To Form 41st A.F.S. Chapter

CENTRAL PENNSYLVANIA FOUNDRYMEN gathered at Pennsylvania State College September 21 to discuss plans for a proposed new A.F.S. chapter. Meeting in the Mineral Industries Building, founders within an approximately 100 mile radius of State College heard Robert W. Lindsay, professor of metallurgy, explain the significance and value of an organized foundry group in the Central Pennsylvania area.

Prof. Lindsay is acting as chairman of the Steering Committee. W. W. Eichenberger, Milwaukee Foundry Equipment Co., Port Royal, Pa., who attended the 1949 Chapter Officers Conference to get first-hand information on A.F.S. chapter formation and operation, is secretary. Prospective Steering Committee members approached at the meeting agreed to serve and others have been contacted to complete the organizing group.

Next meeting of the proposed Central Pennsylvania Chapter will be held in the Mineral Industries Building at Pennsylvania State College starting at 7:30 p.m., October 26. Speaker will be an authority on cupola operation. Details will be announced to Central Pennsylvania foundrymen by letter about 10 days prior to the next meeting of the proposed A.F.S. Chapter.

French Foundry Productivity Team Studying U.S. Gray Iron Techniques

A 16-MAN TEAM of French gray iron foundrymen started a six-week tour of United States foundries and foundry centers in Chicago October 3. Part of some 1000 men to be sent to this country to study production methods and techniques, the group is only the second to visit here. Visitations are sponsored by the Economic Cooperation Administration and the French Ministry of Industry and Commerce as part of the French industrial productivity program. Objects of the program are to raise France's standard of living, to meet production with present labor forces, and to reduce costs to conform with the export market.

Technical meetings and visitations, planned in large part by United States and French government officials and A.F.S. Headquarters, are being carried out largely through the cooperation of Society members. First three weeks of meetings, being held in Chicago and the immediate vicinity, started with attendance at the first fall meeting of the A.F.S. Chicago Chapter.

Returning to France where production of an automobile requires three times as many man hours as in the United States, team members will apply ideas developed here in their own plants, will lead discussion groups at all personnel levels, and will prepare reports for distribution to French foundrymen. On the foundry team are a group leader from the French Foundry Technical Center, three foundry owners, five engineers, three foremen, and six production workers. They represent companies in the field of automotive parts, machine tools, agricultural equipment, and naval construction. Assisting the team are three translators and a typist.

The gray iron foundries of France number about 900 and are operated by some 850 companies. They are located primarily in the east, north, and near Paris, with some in Brittany. Production in 1948 is estimated to be close to 620,000 tons divided approximately as follows: mines and steel industry, 20 per cent; automotive, 15; railroad, electrical, agricultural, and machine tool, 10 each; textile machinery, 5; and the balance miscellaneous castings.

French gray iron foundries employ about 40,000 workers and about 5,000 supervisors, clerks, etc. Production employees average about 45 per plant.

Continue Chapter Contacts Work

CHAPTER CONTACTS COMMITTEE plans have been announced by the chairman, Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, Vice-President of American Foundrymen's Society, and have been distributed to all National Officers and Directors. Instigated last year by the present President, Edwin W. Horlebein, Gibson & Kirk Co., Baltimore, the program calls for a visit by some National Director to each A.F.S. chapter. Each Director will visit several chapters and all Society groups, including the student chapters, will have contact with at least one National Director during the year. In addition, the President, Vice-President, Secretary-Treasurer, and Technical Director of A.F.S. expect to make as many visits as possible to chapters and annual regional foundry conferences of the Society.

In their Chapter Contacts Committee work, National Directors make a friendly call on the chapter, attending, generally, a meeting of the chapter directors and a chapter meeting. Arrangements to visit a chapter are made with the cooperation of the chapter chairman. Object of the visitations is to effect better liaison between the chapters and the Society's governing body, the National Officers and Directors.

Good Future Management Material In College Graduates Say Authors

ENGINEERING GRADUATES are a good source of future management people, according to an article *"Increasing the Competitive Position of Your Company through Better Trained Personnel"* by Graham W. Parker, New York industrial consultant, and Donald F. Lane, formerly with Bethlehem Steel Co., Sparrows Point, Md., chairman of the A.F.S. Foremen Training Committee.

Progressive companies make an effort to select a minimum number of graduates every year, states the paper which has been translated by Mr. Parker into several foreign languages and brought to the attention of management in other countries through various professional periodicals.

Usual practice is to interview applicants at the plant office, say the authors. They point out that better selections result when management representatives visit the college or university and discuss with the dean or placement officer the total background of students who evidence some interest in their particular business. Another means of attracting college graduates into an organization on a permanent basis is to offer summer employment while attending college (see *"FEF Objectives Fulfill Industry Need,"* page 21 of this issue.)

College graduates should be given an opportunity to learn the business in its broadest aspects. This can best be accomplished by providing a plan of departmental orientation whereby the college trainee is scheduled to observe and work in such departments as sales, engineering, laboratories, production, shops, accounting, purchasing, etc. At the termination of such a training period, which might range from six months to two years* depending upon the size and diversity of the industry, the college trainee should be permanently placed in a department that will take advantage of his interest, training, and natural abilities.

His first assignment should definitely be of a non-supervisory type. If possible, he should be given an opportunity to develop certain basic plant skills which would give him a foundation upon which to build future supervisory responsibilities. His association with rank and file will prove of immeasurable value in future years if he develops managementwise. Once college graduates are permanently placed, they should not be treated differently from any other employee. They should be elevated or given management status only after they have proved themselves on the job.

* Minimum of 18 months, preferably two years, is recommended in *"Foundry Training Course for College Graduates,"* report of the A.F.S. Committee on Training Graduate Engineers in Industry, AMERICAN FOUNDRYMAN, May, 1947, page 97.

ANNOUNCE PROGRAMS OF THREE REGIONAL FOUNDRY CONFERENCES

FINAL PROGRAMS AND PLANS have been completed for three more of the nine A.F.S. Regional Foundry Conferences planned for the 1949-50 season—the Metropolitan Regional Foundry Conference, October 21-22; the Michigan Regional Foundry Conference, October 28-29; the Purdue Metals Casting Conference, November 3-4. A tentative program has been arranged for the New York State Regional Foundry Conference, November 25-26.

Two regional meetings were held earlier this month and will be reported in detail in the November issue of AMERICAN FOUNDRYMAN—Eastern Canada Chapter's Sherbrooke Meeting, September 30-October 1; and the New England Regional Foundry Conference, held at the Massachusetts Institute of Technology, October 7-8. Preliminary plans have been completed for the Ohio Regional Foundry Conference, to be held March 10-11 in Cincinnati; the Birmingham Regional Foundry Conference, February 2-4, and the Wisconsin Regional Foundry Conference, whose date will be announced in the near future.

METROPOLITAN REGIONAL CONFERENCE

Sponsored by the Metropolitan, Chesapeake and Philadelphia Chapters, the Metropolitan Regional Foundry Conference will be held at the Stevens Institute of Technology, Hoboken, N. J., October 21-22.

The Conference program will feature separate round table discussions on steel, gray iron and bronze and light alloy casting problems, a luncheon on the Stevens Institute campus, and general sessions on fluid flow and ductile cast iron.

Friday, October 21

9:00 a.m.—REGISTRATION.

9:30 a.m.—Conference called to order by Harold L. Ullrich, Sacks-Barlow Foundries, Inc., Newark, N. J., General Conference Chairman.

10:00 a.m.—Address of welcome by Dr. Harvey N. Davis, President, Stevens Institute of Technology.

10:30 a.m.—ROUND TABLE DISCUSSIONS. *"Gating and Risering"*.

12:00 noon—LUNCHEON. Stevens Institute of Technology.

2:00-3:30 p.m.—SECTIONAL MEETINGS.

Gray Iron—*"Carbon Control in Cast Iron,"* Fred Hanson, Electro Metallurgical Div., Union Carbide & Carbon Corp.

Bronze and Light Alloys—*"Non-Ferrous Foundry Practice,"* C. A. Robeck, Gibson & Kirk Co., Baltimore.

Steel—*"Microstructures and Mechanical Properties of Cast Steels,"* Malcolm F. Hawkes, Carnegie Institute of Technology, Schenley Park, Pittsburgh.

3:30-5:00 p.m.—SECTIONAL MEETINGS.

Cast Iron and Malleable—*"New Trends in Core Binders,"* Joseph A. Gitzen, Delta Oil Products Co., Milwaukee.

Bronze and Light Alloys—*"Recent Progress and Application of Plaster Mold Composition for Use With Non-Ferrous Castings,"* K. A. Mietticke, consulting engineer, Chicago.

Steel—*"Steel Foundry Sands and Their Relation to Casting Defects,"* Howard F. Taylor, Department of Metallurgy, Massachusetts Institute of Technology, Cambridge.

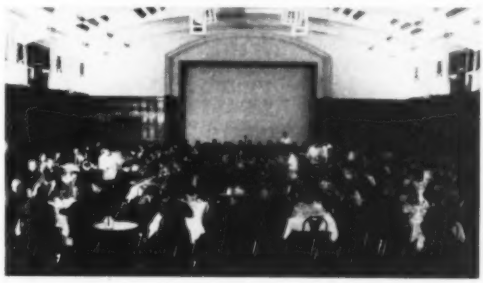
Saturday, October 22

9:30 a.m.—*"Fluid Flow in Transparent Molds,"* L. W. Eastwood, Battelle Memorial Institute, Columbus, Ohio.

10:30 a.m.—*"Ductile Cast Iron,"* William C. Mearns, International Nickel Co., New York.

Committee chairmen for the Metropolitan Regional Foundry Conference are:

General Chairman—Harold L. Ullrich, Sacks-Barlow Foundries, Inc., Newark, N. J.; *Arrangements*—Frank B. Eliason, Pennsylvania Foundry Supply and Sand Co., Philadelphia; *Program*—John A. Bukowski, Worthington Pump & Machinery Corp., Harrison, N. J.; *Registration*—Howard Williams, New Jersey Silica Sand Co., Millville, N. J.; *Finance*—Robert Maddison, Republic Steel Corp., New York; and *Publicity*—George Baer, Atlas Foundry Co., Irvington, N. J.



The banquet climaxing the Purdue Metals Casting Conference will again this year be held in the Memorial Union building on the Purdue Campus, Lafayette, Ind.

MICHIGAN FOUNDRY CONFERENCE

The Michigan Foundry Conference, sponsored by the A.F.S. Michigan Chapters, and to be held at Michigan State College East Lansing, October 28-29, will have as its theme "New Developments in the Foundry Industry." Subjects to be covered include mechanization, cost reduction, nodular iron, stress analysis, research, molding materials and cupola smoke control. Climaxing the Conference will be a football game between Michigan State College and Temple University of Philadelphia.

Friday, October 28

8:30-9:15 a.m.—REGISTRATION.

9:15 a.m.—Address of welcome by L. C. Price, Head, Department of Mechanical Engineering, Michigan State College.

9:30 a.m.—KEYNOTE ADDRESS. *"New Developments in the Foundry Industry,"* L. A. Danse, General Motors Corp.

10:15 a.m.—*"Mechanizing for Small Jobs to Produce a Wide Variety of Castings With Extremes in Lot Sizes,"* Frank W. Shipley, Caterpillar Tractor Co., Peoria, Ill.

11:00 a.m.—*"Discussion of Mechanizing Problems,"* Walter Gerlinger, Walter Gerlinger, Inc., Milwaukee, and E. C. Jeter, Ford Motor Co., Dearborn, Mich.

11:00 a.m.—*"Discussion of Mechanizing Problems With Special Reference to Foundry Costs,"* Walter Hummel, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.

12:00 noon—LUNCHEON. *"Activities of the American Foundrymen's Society,"* Edwin W. Horlebein, National President, American Foundrymen's Society.

1:15 p.m.—*"Progress Report on Foundry Research."* H. L. Womochel, Michigan State College.

2:00 p.m.—*"Practical and Social Aspects of Cupola Smoke Control,"* W. N. Witheridge, General Motors Corp.

CASTING STRESS ANALYSIS SESSION.

3:00 p.m.—*"Stress Analysis of Castings,"* William T. Bean, Jr., foundry consultant Detroit, Mich.

4:00 p.m.—*"Discussion of Stress Analysis Problems,"* Frank Tatnall, Baldwin Locomotive Works, Philadelphia.

6:30 p.m.—DINNER AND ENTERTAINMENT.

Saturday, October 29

8:30 a.m.—*"The Effect of Mold Materials on Shrinkage,"* Harold Austin and Walter Bohm, Buick Motor Div., General Motors Corp., Flint, Mich.

9:30 a.m.—*"Discussion of Mold Materials,"* Clyde A. Sanders, American Colloid Co., Chicago.

10:30 a.m.—*"Nodular Iron,"* D. E. Krause, Gray Iron Research Institute, Columbus, Ohio.

11:30 a.m.—DISCUSSION OF NODULAR IRON.

PURDUE METALS CASTING CONFERENCE

The two-day Purdue Metals Casting Conference will take place November 3 and 4 under the joint sponsorship of the A.F.S. Michiana and Central Indiana Chapters and Purdue University at Purdue University, Lafayette, Ind. The first day's program will feature sessions on foundry research, costs and employee relations, followed by a banquet. The second day's program will be devoted to such subjects as heading and gating, production control in the foundry and foundry sands and includes a sand testing demonstration by students in Purdue's Sand Control Laboratory, which will conclude the Conference.

Thursday, November 3

9:00 a.m.—REGISTRATION.

10:30 a.m.—OPENING SESSION. Welcoming address by Dr. A .A. Potter, Dean of Engineering, Purdue University. Response by A.F.S. National Vice-President Walton L. Woody.

"Nodular Gray Iron," C. O. Burgess, Gray Iron Founders' Society.

1:30 p.m.—*"Cost Records and Methods of Determining Costs,"* Ralph Lee, Grede Foundries, Inc., Milwaukee.

"Cost Reduction in the Foundry Through Motion Study," Dr. M. E. Mundel, Professor of General Engineering, Purdue University.

6:30 p.m.—BANQUET. Memorial Union Bldg., Purdue University Campus. Speaker will be Dr. L. M. Sears, Professor of History, Purdue University.

Friday, November 4

10:00 a.m.—*"Metal Flow in Molds,"* S. C. Massari, Technical Director, American Foundrymen's Society. Film and discussion.

"Controlled Product Through Controlled Processes," Arthur Bender, Delco-Remy Corp., Anderson, Ind.

1:30 p.m.—*"Foundry Sands,"* Thomas E. Barlow, Eastern Clay Products, Inc., Jackson, Ohio.

3:00 p.m.—SAND TESTING DEMONSTRATION by students, Sand Control Laboratory, Michael Golden Engineering Laboratories, Purdue University.

Conference Chairman is C. T. Marek, associate professor of manufacturing processes, Purdue University. Headed by Chairman Paul H. Harlan, Electric Steel Castings Co., Indianapolis, the program committee for the Purdue Conference is composed of:

Prof. H. A. Bolz, General Engineering Dept., Purdue University; Keith E. Glancy, conference supervisor, Purdue University; F. A. Honer, Woodward Pattern Works, Inc., South Bend, Ind.; W. F. Lange, Casting Service Corp., LaPorte, Ind.; Roy W. Lindley, Manufacturing Processes Laboratory, Purdue University; Conference Chairman C. T. Marek, Purdue University; V. S. Spears, American Wheelabrator & Equipment Corp., Mishawaka, Ind.; S. Franklin Swain, Golden Foundry Co., Columbus, Ind.; S. C. Massari, Technical Director, American Foundrymen's Society; R. S. Spurgin, Jr., Swayne-Robinson & Co., Richmond, Ind.; and G. M. Enos, professor of metallurgical engineering, Purdue University.

NEW YORK STATE REGIONAL

Tentative program for the New York State Regional Foundry Conference has been announced by Program Chairman L. D. Wright, U. S. Radiator Co., Geneva, N. Y. To be held November 25 and 26 at the Engineering and Science Campus of Syracuse University, Thompson Road, Syracuse, N. Y., the conference includes a number of technical sessions and laboratory visitations. Nodular iron and gray iron specimens will be tested in a demonstration of physical testing during a laboratory visitation preceding formal opening of the conference.

First technical session, the morning of November 25, will deal with nodular graphite cast iron. Sectional meetings in the early afternoon will cover malleable iron, gray iron, non-ferrous, and steel topics. Late afternoon will be devoted to motion and time study with emphasis on elimination of fatigue and unnecessary work caused by waste motions.

Sand will be the subject of discussion the morning of November 26 with Harry W. Dietert, Harry W. Dietert Co., Detroit, as speaker. Laboratory visitations are being arranged for the late morning and early afternoon by Prof. F. R. Morrel and E. Syrene of Syracuse University.

In addition to Program Chairman Wright, conference officials include: E. E. Hook, Dayton Oil Co., Syracuse, general chairman; J. F. Livingston, Crouse-Hinds Co., Syracuse, secretary; and John A. Feola, Crouse-Hinds Co., publicity.

Czech Foundrymen Elect Officers

NEW PRESIDENT of the Czechoslovak Foundrymen's Association is Ing. Dr. Bedrich Zimmermann of Prague who succeeds Prof. Dr. Mont. Fr. Pisek of Brno. President for 26 years, Prof. Pisek recently resigned and was elected honorary president. He was elected president of the International Committee of Foundry Technical Associations at the recent International Foundry Congress held in Amsterdam, Netherlands.

Other officers of the Czechoslovak Foundrymen's Association are: first vice-president, Ing. Alois Vejs, Ostrava; second vice-president, Karel Antonicek, Brno; secretary, Ing. Adolf Vacin, Prague; and treasurer, Vaclav Marel, Brandys.

FERROUS MELTING FURNACES *in the* UNITED STATES AND CANADA

A. W. Gregg
Consulting Engineer
Whiting Corp.
Harvey, Ill.

THE FOUNDRY INDUSTRY has been a vital factor in the industrial development of the United States. Foundries have been obliged to expand and to mechanize all possible operations in order to satisfy the growing demands of industry, particularly the railroads, automotive plants, builders of agricultural machinery, the mining industry, the public utilities, and the manufacturers of plumbing and sanitary ware.

The great distances in the United States from north to south and from east to west have created tremendous transportation problems necessitating thousands of miles of railroads and millions of automobiles, buses, and trucks. The great central area, with its large-scale farms, could not be operated efficiently without farm machinery such as tractors, harvesting machinery, trucks and various kinds of soil tilling machinery.

Many foundries have mechanized and modernized operations, and in so doing have increased the productive capacity of individual plants. Considering

This year's Official Exchange Paper from the American Foundrymen's Society to the International Foundry Congress was presented at the Meeting held in Amsterdam, Holland, Aug. 29-Sept. 2, 1949. Briefed in this issue of *American Foundryman*, the complete paper will appear in A.F.S. *Transactions* for 1950.

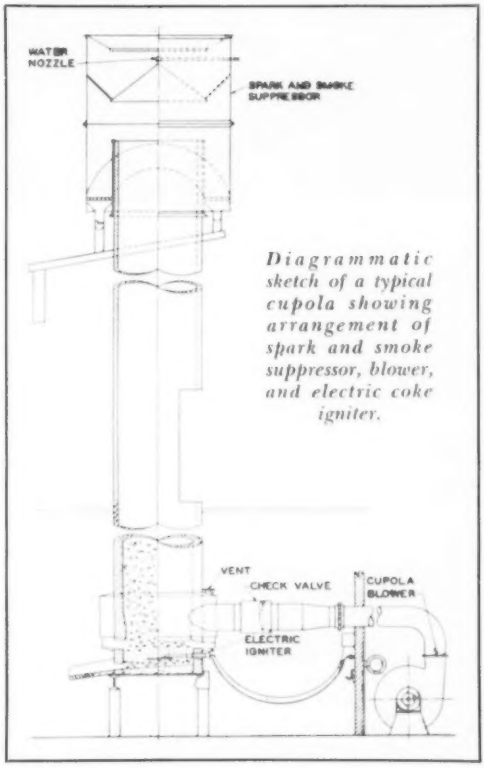
both the increase in number of plants and added capacity provided by modernization, it seems probable that the foundry industry in America now has facilities to produce greater tonnages than ever before.

Capacity of all foundries is estimated at 15 to 16 million net tons of castings per year. The industry employs some 400,000 people, and the annual payroll is about one and one-quarter billion dollars. The total annual value of castings produced in the United States is something over 4 billion dollars.

The influence of the American Foundrymen's Society has been most constructive. Cooperative research and exchange of information have had a tremendous influence in the development of improved foundry practice, better quality castings and lowered costs. The Society, for over 50 years, through its literature and promotion of exhibits of new equipment has stimulated the advance of the industry. One of its earliest projects was the development of an apprentice training program which has been backed up annually for many years with a contest for molder and pattern maker apprentices.

The A.F.S. Sand Research Committee has been in existence for nearly 40 years and has developed standards and methods of testing foundry sands which are internationally accepted.

Manufacture of chilled iron car wheels furnishes an excellent example of a highly mechanized foundry serving the railroads and specializing on one kind of casting. In four years—1945 to 1948 inclusive—car



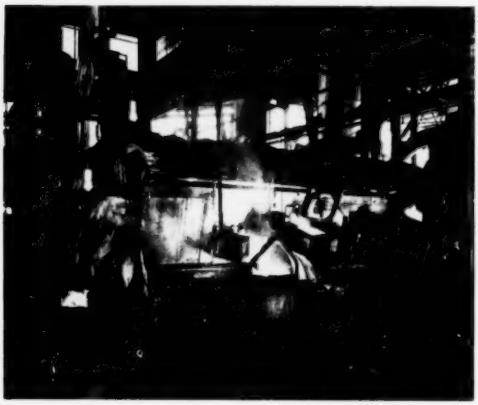
Diagrammatic sketch of a typical cupola showing arrangement of spark and smoke suppressor, blower, and electric coke igniter.

wheel foundries shipped 12,932,000 wheels, having a total weight of 4,744,000 net tons. This is an average of 1,186,000 net tons of car wheels shipped per year.

Gray Iron Foundry Industry

The oldest and still the largest branch of the foundry industry in America is that manufacturing gray iron castings. The earliest iron casting made in America was cast in 1642. This was a cooking vessel manufactured by the Saugus Iron Works, near Lynn, Mass. The metal was made in a crude blast furnace capable of producing about 8 tons of pig iron per day.

Gray iron foundries in the United States and Canada number 3,457, of which 373 are in Canada. These foundries operate 4,979 cupolas having a total estimated hourly capacity of 36,569 net tons. Of these foundries, 25 per cent employ mechanical chargers, and 75 per cent of the cupolas are still hand charged. Forty per cent of all cupolas are over 20 years old. About 40 per cent of the gray iron foundries have



A 10-ton cradle furnace, fired with powdered coal, is used in duplexing practice. Cupola metal may be tapped directly into the furnace, or delivered by ladle.

sand testing laboratories, about 30 per cent have physical testing laboratories, and about 35 per cent have chemical laboratories.

Cupola Melting Furnaces

The cupola is almost the universal melting unit, and the annual weight of iron melted in cupolas in a good year is 15 to 16 million net tons. This represents a production of about 12 million net tons of gray iron castings.

Cupolas are built with shell diameters of 26 to 130 in., and diameters inside the lining range from 17 to 90 in. or more. Cupola melting capacities are based on 10 lb per hr per sq. in. of area inside the lining, and the melting rates are from one ton to 30 or 35 tons per hour. Heights range from 30 to 90 feet from grade to top of stack. Tuyere area compared to area inside the lining varies from 10 to 25 per cent. The number of tuyeres varies from four on a small cupola to 16 on a cupola having a shell diameter of 130 in.

Coke is the favored cupola fuel, and is almost universally used. During the past two or three years when coke was in short supply, some foundries used a percentage of anthracite coal.

Naturally, the cupola melting loss is extremely variable, depending upon the character and cleanliness of the metallic charge. With clean scrap and pig iron and good operating conditions, the melting loss may be as low as 2 per cent. With oxidized, dirty or light-section scrap, melting loss may be as high as 10 per cent. With a large percentage of steel scrap in the charge, the melting loss will be about 6 per cent.

Other Furnaces for Gray Iron

Although the cupola produces about 98 per cent of all gray iron melted in the United States and Canada, a small tonnage of cast iron is made in electric furnaces, and the greater part of the iron used for chilled rolls is made in open hearth or air furnaces.

The electric furnace is used for melting special and alloy grades of cast iron. Some of the manufacturers of individually cast piston rings have always used the electric furnace.

Because coke in the United States since the war has been at an all-time high in cost, and quality has been much below the standard of pre-war years, some gray iron foundries are considering electric melting, and several have installed small electric furnaces to superheat cupola metal. Duplexing with cupola and electric furnace has an advantage over cold-melt electric furnace practice because it maintains the advantage of a continuous supply of molten metal.

Cradle Furnace

Used in connection with cupola melting the cradle furnace serves as a heated mixing and distributing ladle. Metal temperature can be maintained or slightly increased, and uniformity of composition is greatly improved.

Cradle furnaces are built in sizes ranging from 3 to 25 tons holding capacity. They are usually fired with pulverized coal. The tilting mechanism is power operated. Cupola metal can be tapped directly into the cradle furnace, or delivered to it with a ladle if the furnace is located at some distance from the cupola. The pouring spout is located on one side of the furnace. A pour-in spout and a skimming opening are located on the opposite side. The refractory material used for side walls and roof consists of silica brick or high temperature duty clay brick. Monolithic rammed bottoms are popular. Roofs are bung type.

Mechanical Charging

Undoubtedly one of the greatest improvements in cupola operation is due to the introduction of mechanical charging equipment. There are many types, ranging from the simple vertical skip hoist capable of serving a single cupola and usually employed on smaller sizes, to the elaborate complete systems serving a number of cupolas of any size.

The make-up system in the stock yard for a complete installation employs a traveling crane with a magnet, an iron loading platform with a weigh hopper, and a coke and stone bin with a weigh hopper, from which these materials are delivered by gravity into the charging buckets. A transfer car is used to

move the loaded buckets from the make-up point to the pick-up point under the charging crane. Instead of a traveling crane for charging, some installations employ an inclined skip hoist which may serve one or more cupolas.

A completely mechanized charging installation employs from two to three men and can handle up to 40 tons per hour. In some plants, 20 men or more have been replaced by three.

Each installation should be individually engineered to comply with local requirements and conditions. Complete mechanical charging installations not only cut labor costs, but also eliminate hard manual labor and provide safer and more pleasant working conditions. They also encourage greater accuracy and better housekeeping.

Steel Foundry Melting Furnaces

In the United States and Canada, there are about 300 steel foundries making commercial castings, of which 22 are so-called captive foundries. According to the Steel Founders' Society of America, the industry in a normal year ships between 900,000 and one million net tons of castings. In the peak year of 1942, production was 1,679,178 tons. Railroads consume 35 per cent of the product, machinery and tools 25 per cent, rolling mills 15 per cent, and the remaining 25 per cent is scattered among many different industries. Upward of 20 per cent of the steel foundries' output is alloy steel of various compositions.

Electric arc-furnaces are by far the most used melting furnaces, especially for the production of small and medium size castings. In 1948, 43½ per cent of total tonnage produced was made in electric furnaces. The open-hearth furnace is used for large tonnages and heavy castings. The side-blow converter is used to produce steel for light castings of thin sections. The crucible furnace was the first steel melting unit for the production of small steel castings and had this field almost entirely to itself prior to the introduction of the side-blow or Tropenas converter into the United States about 1890.

The electric arc-furnace had its first big start in the steel foundries of America during World War I, and continued to expand its field during World War II. In 1948 about 425 electric arc-furnaces were in use in the steel foundries of the United States and Canada. These furnaces range in holding capacity from 500 lb to 50 tons; 61 per cent are less than 10 years old. The 2-to 3-ton furnace is the size in most general use in foundries specializing in small and medium size work.

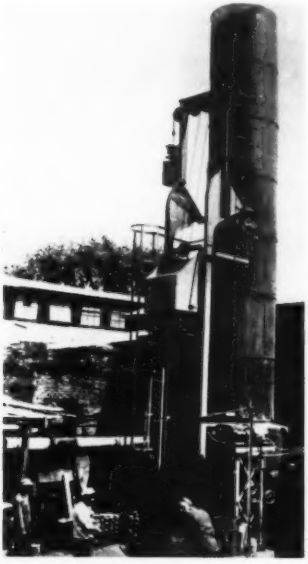
Most of the furnaces built during the past 5 years have been of the top-charge type. Top-charge furnaces reduce the time between heats to a minimum, with a consequent saving in power and an increase in production. Also, a saving is made in yard labor as charges are generally made up with a magnet yard crane.

The majority of electric furnaces in steel foundries are operated with acid linings. This was customary before the war because in ordinary times low phosphorus, low sulphur scrap was in good supply. During the last war, however, some 65 foundries were obliged to change to basic practice when low phosphorus scrap was practically unobtainable.

Triplexing Operation

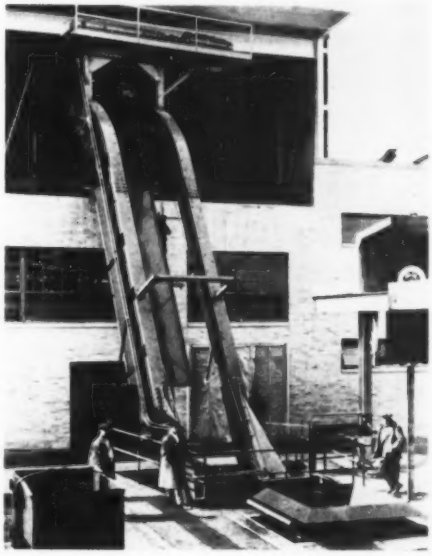
An interesting process, developed and operated by a large steel foundry in Michigan, is known as triplexing. The charge, consisting largely of steel scrap, is melted in a cupola. After desulphurizing in the ladle with alkali slags, the metal is blown in a side-blow converter. The converter metal is deoxidized in the ladle with manganese, silicon and aluminum, and delivered continuously to an electric furnace which has a holding capacity of about three converter blows and is kept reasonably full.

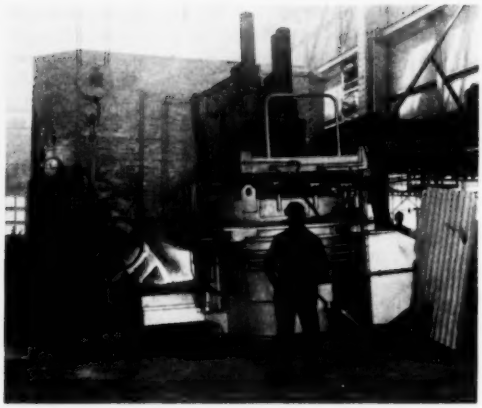
Metal from the electric furnace is delivered to pour-



Vertical skip-hoist charger installed in a small foundry. Charges are made up by hand and moved to skip bucket in wheelbarrows.

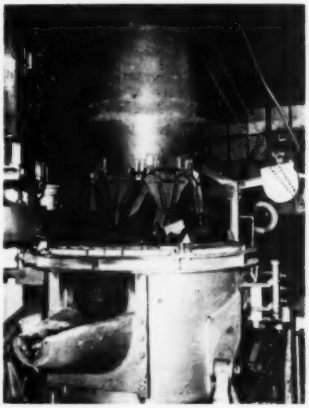
Swivel-type skip hoist capable of charging two or more cupolas. Charges are made up with a magnet crane and delivered to hopper shown in foreground.





A 6-ton electric-arc furnace used in duplexing practice in production of alloy cast iron.

Charges for the top-charge type of electric-arc furnaces are usually made up by a magnet yard crane. Charging time is reduced and production increased.



ing ladles suspended on a mono-rail, and is poured into molds on a moving conveyor. The electric furnace in this process functions as a heated distributing ladle. Metal temperature and carbon content are checked after each delivery of metal from the converter. Power consumption in the electric furnace is about 50 kilowatt hours per ton. This process has interesting possibilities for continuous high capacity production of steel castings. It makes possible in a steel foundry the benefits of continuous molding and shakeout operations.

According to the directory of the Steel Founders' Society of America, there are 121 open-hearth furnaces in 45 steel foundries in the United States and Canada. Seventy-one per cent of these furnaces are over 20 years old, and only 8 per cent are under 5 years.

Open-hearth furnaces in foundries range from 10- to 50-tons capacity. The size in most general use has a capacity of 30 tons. Oil is the most popular fuel, with natural gas of 1000 B.T.U. per cubic foot in use where price is favorable and supply dependable. Some furnaces are fired with a mixture of oil and gas, and a few are fired with producer gas.

Open-hearth furnaces produce about 50 per cent of the total tonnage of steel castings. The yield of castings compared to molten metal varies from 50 to 75 per cent.

Open-hearth furnaces are economical only for large tonnages and heavy castings and, for best results, should be kept in continuous 24-hr operation.

Side-Blow Converter

The first Tropenas side-blow converter to make steel for castings was installed in a foundry in the city of Milwaukee, Wis., in April, 1899. The side-blow converter soon replaced the crucible furnace for the manufacture of small and medium size steel castings because of its lower operating costs and ability to produce steel of high temperature in large quantities.

At one time there were over 50 foundries in the United States making steel castings with the side-blow converter, and from about 1900 until World War I it was the favored process for the production of steel for small castings.

At the present time, according to the directory of the Steel Founders' Society of America, there are 21 foundries in the United States and Canada operating 32 converters. The vessels range in size from 1-ton to 6-ton holding capacity. The size in general use has a holding capacity of 2 tons. All converters at present are operated with acid lining. The positive impeller type of blower is used almost universally. The usual rating for a converter blower is based on 1400 to 1600 cu ft per minute per ton of holding capacity, at pressures ranging from 4 to 5 lb.

Molten metal for the converter charge is supplied by cupolas, the composition being about 3 per cent carbon, 0.60 to 0.70 per cent manganese, and 1.50 to 2.00 per cent silicon. The cupola charge consists largely of steel scrap. Because the converter operates with acid lining, phosphorus and sulphur in the charge must be within the specified limits for the finished steel.

Cupola metal is desulphurized with soda-ash and caustic soda. With careful practice, upward of 70 per cent of the sulphur in the metal can be removed with certainty.

Practically all converters in America have rammed monolithic linings composed of silica ganister and a binder. A few operators use silica brick. Lining life is variable, depending upon the care taken in ram-

Molten metal for the 2-ton capacity side-blow converters is supplied by the cupola shown at the left.

ming and drying. Fifty to 100 blows can be made on a lining with proper practice, and some foundries have made as many as 200 blows on a lining.

High Frequency Induction Furnaces

The high frequency electric furnace has been gaining steadily in popularity during the past 10 years, although the first production unit was not installed in the United States until 1930. It is used principally for the production of alloy steels, and especially for alloy steels of the corrosion and heat resistant types.

In the United States, 35 foundries are now operating 88 induction furnaces, ranging in capacity from a few pounds to 2000 lb, but the usual size in the production foundries rarely exceeds 1000 lb. Transformers are usually rated on the basis of 800 kw per ton of furnace holding capacity. These furnaces are lined with either acid or basic refractories. The time of melting varies with the size of the furnace, the size of the charge, and the power input.

Heats are made from clean, selected scrap containing alloys of known composition. The furnace charge must be of good density. As the change in composition is exceedingly small during the melting operation, steel can be made with accuracy to a given specification. In most operations, no slag is used. The induction furnace must be classified as a steel "melting" unit rather than "refining" unit.

Numerous alloy compositions are required in the chemical and other industries, and quantities ordered may be small. The rather small capacities of the induction furnaces in operation are admirably adapted for such service. High alloy scrap of known composition can be used in the charge without loss of alloys through oxidation.

Malleable Iron Industry

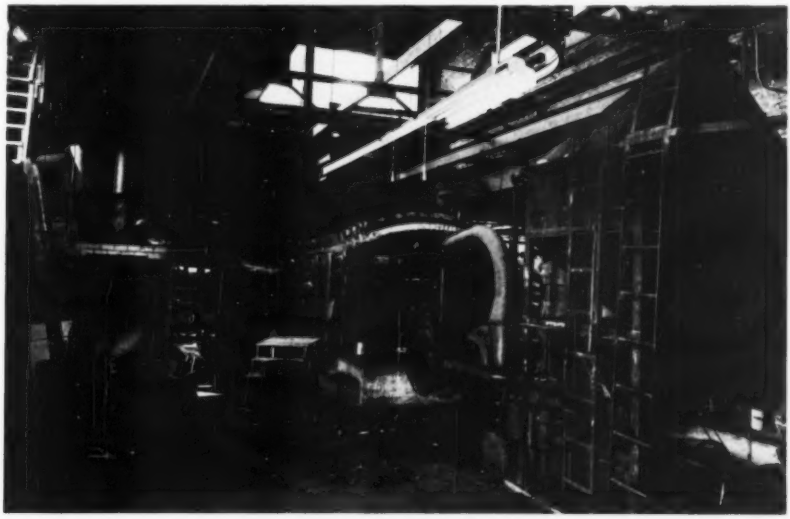
All of the malleable iron castings made in America are of the well-known blackheart type, which was discovered and developed by Seth Boyden at Newark, N. J., during the years 1826 to 1832. Boyden, whom Thomas Edison called "one of America's greatest inventors" started his experiments with the idea of duplicating the whiteheart malleable iron developed by Reamur in France about 100 years earlier and commonly produced in Europe today.

The high-frequency electric furnace is used principally in high alloy steel production.

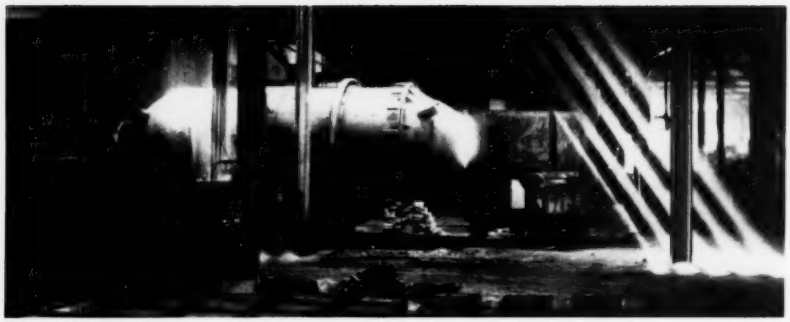
In the early days of the industry in America, malleable iron was melted either in crucible furnaces, or in a small and very crude type of cupola. A low-silicon charcoal pig iron was charged and high-carbon white iron produced. Small air furnaces of 800- to 1000-lb holding capacity soon supplanted the cupola and the crucible furnace. Melting and annealing practices were based on rule of thumb, and any improvements were regarded as trade secrets and zealously guarded as such.

Today, under the influence of the Malleable Founders' Society, there is a free interchange of information, even among competitors, and all melting and annealing operations are conducted under scientific control.

In the United States and Canada, over 100 found-



Malleable foundry duplexing operation—cupola to powdered-coal-fired air furnace. Coal bin and pulverizer are shown at the right.



The Brackelsburg furnace is a rotary type of air furnace, generally powdered-coal-fired. The installation shown is a 5-ton furnace for a malleable duplexing operation.

ries are making malleable cast iron, with production in a normal business year of one million net tons. Fifty per cent of this tonnage is consumed by the automotive industry, and most of the remainder is used in about equal amounts by the railroads and the manufacturers of agricultural machinery. The malleable foundries operate a total of about 250 air furnaces, and 50 per cent of the foundries are making castings with metal produced by the cupola-air furnace duplexing process.

Sixty to seventy per cent of the total tonnage of malleable iron is now made by the duplex process, and the greatest number of installations involve cupola to air furnace equipment. Grade A malleable iron is readily produced by this method. At least 90 per cent of all air furnaces are now fired with powdered coal. A few air furnaces are fired with oil, and a few are still hand-fired with coal.

One of the foundries using the cupola to electric furnace process has a rated capacity of 90 tons of melted metal per hour, and in peak periods operates 16 hr per day. This foundry has produced in excess of 650 net tons of finished castings per 16-hr day. With continuous operations, the cupola-electric furnace process produces Grade B malleable iron, but if operated as a batch process can also produce Grade A.

The advantages of the continuous duplexing process may be listed as follows:

1. Because this process supplies metal continuously, it makes possible the advantages of continuous mechanized molding and pouring practice.

2. Maximum production from a minimum of floor space and a minimum of personnel.

3. Higher efficiency in practically all foundry departments due to specialization of pouring, shifting and shakeout operations.

4. Opportunity to improve housekeeping and working conditions, which tends to attract better workers.

Successful Use of Undesirable Melting Stock

During the war, foundry operators in all branches of the industry were obliged to charge melting stock which a few years earlier would have been rejected after visual inspection. By careful control and the use of alloy additions, the foundries have been successful in maintaining the quality of their various products. Iron foundries found it necessary to improve desulphurizing practice.

Use of borings in the cupola charge was made possible by the development of efficient briquetting machines, which produced easily handled briquettes having very high density. Large hydraulic presses for making bundles from light-gage sheet metal made satisfactory melting stock for open hearth and electric furnaces.

The present high state of development in the foundry industry is largely the result of extended research, not only by scientific and trade organizations, but by the foundry operators themselves, and free exchange of information between foundrymen. Free interchange of ideas and continuous search for new facts and improved methods is the path to future advancement in this basic industry.

Acknowledgments

The author wishes to express his appreciation for the assistance accorded him in the preparation of this paper. This came from friends in the foundry industry, and he is especially indebted to the following: S. C. Massari, technical director, American Foundrymen's Society; C. W. Briggs, technical director, Steel Founders' Society of America; James Lansing, technical director, Malleable Founders' Society; W. R. Jaeschke, Whiting Corp.; Anthony DeYoung, Whiting Corp.; Erle Ross, Penton Publishing Co.; and the technical staff of Whiting Corp.

Among the references consulted, the following have been used freely:

Penton Foundry List.

Handbook, Steel Founders' Society of America.

Handbook, Malleable Founders' Society.

A.S.T.M. Report, "Comparative Quality of Converter Steel," vol. 42, 1942.

Directory of Iron & Steel Works, United States & Canada, 1948, published by American Iron & Steel Institute.

Bruce L. Simpson, DEVELOPMENT OF THE METAL CASTINGS INDUSTRY, published by American Foundrymen's Society, 1948.

W. C. Wick, "Oxygen-Enriched Cupola Blast," A.F.S. TRANSACTIONS, vol. 56, pp. 246-259 (1948).

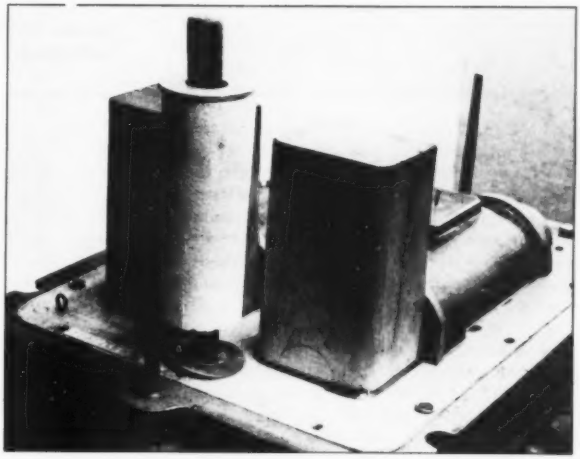
URGENTLY NEEDED

VOLUME 56 (1948) TRANSACTIONS

Bound copies of this volume in good condition will be purchased by A.F.S. Headquarters. Members who have no further use for their copies are urged to write The Secretary, American Foundrymen's Society, 222 W. Adams, Chicago, 6.

...MODERN FOUNDRY METHODS

Four sizes of single-unit downgate cores which are used in the production foundry, with a sectioned core showing interior detail.



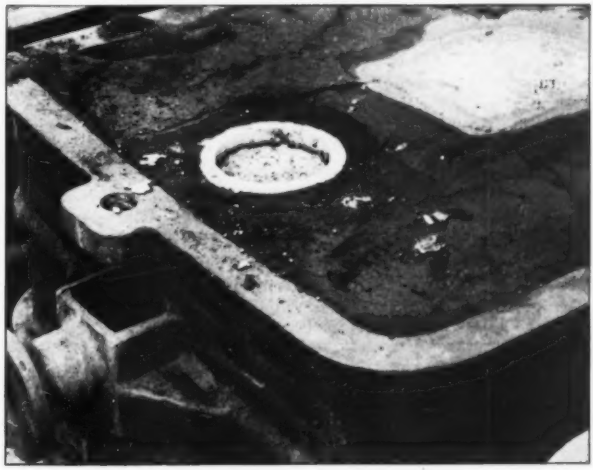
A wedged-up downgate is mounted on the pattern board. In this method a rubber pad is placed on the pattern board to absorb the jolting shocks during molding operations.

A typical application of the downgate core is shown in this completed mold.

Molding practice which includes the use of downgate cores presents two problems to the foundry supervision—whether to make the core as a whole core or as a paste core, and the development of a method which will insure the consistent production of cores of sufficient density to withstand penetration and erosion. In addition the cost of manufacturing the core must be considered.

In an attempt to solve the core problem, the Key Co., East St. Louis, Ill., considered the use of a tile downgate, but the cost proved to be prohibitive. F. B. Riggan, general manager of the company, then suggested the combination of a runner cup and the downgate into a single unit.

As reported by A. E. Czechowicz, superintendent, the new method made it possible for the coreroom to produce downgates of uniform quality at a cost less than the combined cost of the sand pouring cup and the sand downgate formerly used.



View of the mold surface and runner cup portion of the downgate core after pouring.

What's in a Name?

Second section of this roundup of opinion on terminology will appear in the November issue of *American Foundryman*.

SHAKESPEARE PUT IT: "A rose by any other name etc." Very nice. But what about this newest member of the cast ferrous alloys family? Already the metallurgists have divided themselves into several nomenclature camps on whether this newest type of cast iron should be called nodular, spheroidal, globular, lump, or something else . . . including nodulite.

What should the castings buyer (or, for that matter, the poor editor of a technical publication) do under these circumstances? The difficulty lies in the fact that the proponents of each name refer not only to an end product but equally to the technique employed, the alloying elements use, and even to such touchy questions as patent and proprietary rights and precedence.

As a technical society, A.F.S. believes this question of nomenclature should be resolved soon, and accordingly is seeking the opinions of all concerned—metallurgists, producers, buyers, et al. Two names in particular thus far have been most widely accepted in the industry—nodular and spheroidal—but it does not appear that they are safely (or perhaps metallurgically) interchangeable. What, then, is the answer?

Other industries have faced this problem, and have let the buying public make the rules. Consider camera (a generic term) and Kodak (a trade name); phonograph vs. Victrola; electric refrigerator vs. Frigidaire, etc. The list is long, the lesson well learned in the consumer industries.

Perhaps the producers' answer to the present dilemma lies, eventually, in adoption of individually copyrighted trade names. But that still does not solve the problem for a technical society or publication, or a specifications writer, who cannot in fairness to all use trade names.

Well, just what *is* in a name? What's your opinion—and reason? No "coined" name, it seems to us, will do. It must be a *generic* term that the industry is willing to adopt and use freely, and which a castings buyer can specify safely. After that (but not before), the merits of individual or specialized technique, practice, and application can be brought to bear full force in the competitive market that seems bound to result from development of this truly revolutionary (even if now miscalled) product. *Tell us what you think!*

—Editor

Historically, the word "nodular" has been used for many years in the malleable iron industry to describe the irregular, roughly spherical masses of graphite in annealed malleable iron, to distinguish this form of precipitated graphite from the flake form present in gray cast iron, and the terminology was reasonable and satisfactory.

Morrogh, in describing his work on the production of graphite in the spherical or nodular form in nickel-carbon alloys, cobalt-carbon alloys, and later in iron-carbon-silicon alloys, in the as-cast state, used the term "nodule" to describe the ball-shape of the precipitated graphite, and the adjective "nodular" followed naturally.

This procedure was logical from Morrogh's viewpoint, since the spherical masses of graphite present in English whiteheart malleable re of the same compact, uniform crystal structure as the nodules now produced in iron as-cast, and the extension of the term "nodule" to designate all spherical masses of graphite, however produced, followed.

In annealed blackheart malleable iron, the roughly spherical masses of graphite present are composed of aggregates of tiny graphite flakes, as is well known, while the graphite present in whiteheart malleable iron or in magnesium- or cerium-treated cast irons is apparently a homogenous crystal, as shown in Fig. 1. In Fig. 2 is shown the same nodule in polarized light, and the uniformity of structure is inferred.

Graphite in blackheart malleable iron shows no such effect in polarized light. A second point of differentiation between the graphite in blackheart malleable iron and in magnesium- or cerium-treated iron is in the smoothness of outline, the latter usually approaching and frequently having perfect spherical

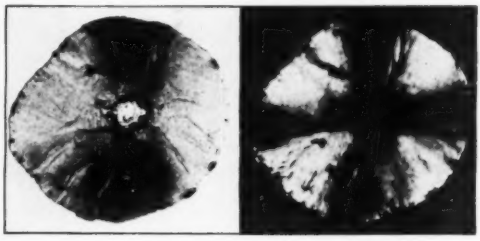


Fig. 1 Fig. 2

Graphite nodule (Fig. 1) and the same nodule in polarized light (Fig. 2). X1500 (reduced approx. 40 per cent).

G. Vennerholm

C. E. Rehder

shape, while the former are usually quite irregular in outline.

Although the above described differences in structure of the graphite masses do exist, the terms "nodular," "spheroidal," "spherical," and "spherulitic" are all designations of external shape or form, and so can all be accurately applied to describe any ball-shaped masses of graphite, and have all been used in the literature of malleable iron.

The only question then would seem to be one of designating the particular type of graphite crystallization found in magnesium- or cerium-treated irons, to distinguish it from the flake-aggregate type in blackheart malleable. This cannot be done by a shape or form designation, and so the question of terminology of these new irons is not based on logic but on custom.

Any of the terms "nodular," "spheroidal," "spherical," or "spherulitic" should then be suitable, with the choice being based on the implied meaning. Since "nodule" and "nodular" are familiar words in connection with iron metallurgy, and through decades of use are familiar as designations of ball-shaped masses of graphite in iron, it would seem that these terms would be best applied to the new cast irons, and indeed, already are the subconscious choice of most workers in the field.

J. E. Rehder, *Foundry Engr.*
Div. of Physical Metallurgy
Bureau of Mines
Ottawa, Ont., Canada

Relative to the proper designation for iron containing graphite in rounded form in the as-cast condition, we find the following definitions in Webster's:

Spherulite—A spherical crystalline body made up of radiating crystal fibers often found in vitreous volcanic rocks, as obsidian and pearlite.

Spheroid—A figure like a sphere, but not spherical, esp., an ellipsoid of revolution.

Spherical—Having the form of a sphere, or one of its segments.

Nodule—A rounded mass of irregular shape; a little lump.

Nodular—Pertaining to, characterized by, having, or in the form of, nodules, as nodular structure.

Globular—Having the form of a ball or sphere.

Ductile—Capable of being permanently drawn out or hammered thin; said especially of metals; capable of being molded or worked; specifically, capable of being drawn out into wire or thread.

When compared in its figurative sense with plastic, malleable, and tractable, ductile is stated as: That is ductile which is pliant, flexible, or capable of being drawn, conducted, or molded whether with or without effort.

It appears quite evident from these definitions that the terms "spheroid" or "spherical" as well as "globular" and in particular, "ductile" are terms which do not properly characterize this material. The best definition undoubtedly is "spherulitic" but this word is somewhat more cumbersome than "nodular" which latter, although it does not fully designate the condition at hand, is so simple and already so widely adopted that it is our recommendation that it be used to designate this new type of iron.

Gosta Vennerholm, *Met.*
Ford Motor Co.
Dearborn, Mich.

The proper terminology for iron in which all the graphite is present as spherulites could be "cast iron with wholly spherulitic graphite in the as-cast condition." Such a periphrase is not at all practical, and we feel that foundrymen would not use it.

However, the proper designation will always be one employing a circumscription; in fact, it is not the iron but the largest amount of the contained graphite that is spherulitic and even the term given above is not exact as often, if not always, a small amount of non-spherulitic graphite will be present.

The above considerations, and especially the practical aspect of this question, incline us to suggest the simplest possible nomenclature for this new type of iron: thus we suggest "nodular iron" rather than "nodular graphite iron" or "spherulitic graphite iron."

The first designation is international and corresponds to the French "fonte nodulaire," while the two following designations need a periphrase in French ("fonte à graphite nodulaire" or "fonte à graphite spherolitique").

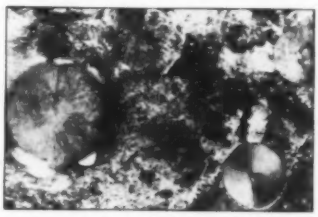


Fig. 3—Pearlitic nodular iron, as-cast. X200.

It further appears desirable to distinguish at least between the as-cast and the soft annealed or completely ferritized condition. Even in the as-cast condition one may produce two different types of nodular iron and, of course, the intermediates.

The first type has a complete or nearly complete pearlitic matrix (Fig. 3) and corresponds to very high strength iron, for example, 120,000 psi. The elongation is rather low, 2-3 per cent (American A test bar), with almost no reduction of area. It does not appear desirable to designate such a material as "ductile."

X300

X100

Fig. 4—Ferritic nodular irons, as-cast.

The second type has a complete or nearly complete ferritic matrix in the as-cast condition; although we have not yet been able to obtain the wholly ferritic matrix as-cast, it may be quite possible. The micrographs of Fig. 4 correspond to the proposed ferritic nodular iron with over 90 per cent ferrite in the as-cast condition, tensile strength of about 80,000 psi, and elongation of 10-15 per cent (American A test bar).

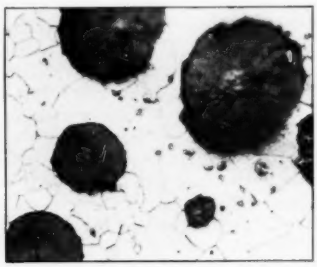


Fig. 5—Ferritized nodular iron, annealed. X300.

The third type is the as-cast nodular iron (Type 1, Type 2, or intermediates) after complete ferritization by annealing (Fig. 5). The designation "ferritized nodular iron" makes it evident that the iron was nodular as-cast.

According to the properties (tensile strength, 75,000 psi, elongation, 20-25 per cent (American A test bar), reduction of area, 25-30 per cent, and Bhn, 150-160) that type of iron may also be called "nodular malleable iron" but, as the heat treatment is mainly ferritizing instead of nodulizing and ferritizing, we should prefer the designation "ferritized nodular iron."

The proposed nomenclature, being practical and presenting an international character, has a further advantage; as nodular iron responds to heat treatment, the nature of the matrix after treatment may impose the designation "austenitic, bainitic, or acicular nodular iron."

Prof. Albert De Sy
University of Ghent, Belgium

Until a few years ago cast iron nomenclature was not a problem, but new offspring in the family of cast irons such as nodular graphite cast iron and acicular cast iron made the whole picture of cast iron designations confusing. The only possible solution appears to be the development of a completely new nomenclature on a systematic basis.

The nomenclature, at least in cast iron specifications, should be logical and based on structure since structure determines the specific properties of the irons. Also, most of the new cast irons have derived their names from some structural component. Since cast iron contains excess carbon as free graphite or carbide in a steel matrix, both the nature of the carbon and the matrix should be incorporated in the designations. Furthermore, the terms should lend themselves to international understanding; hence Latin roots should be used where new terms must be developed. The following designations are suggested for carbon:

Foliolitic graphite = flake graphite (from Latin folium = leaf)

Spheroidal graphite (or nodular graphite, which term however does not describe the shape of the graphite particles quite adequately and has been used earlier for certain types of temper carbon that do not grow radially)

Floccular graphite = temper carbon (from Latin floccus = flock)

Carbide.

By combining the carbon designation and the matrix designation any cast iron can be completely defined and distinguished from other irons. The system suggested has one drawback—the names become a little too long. However, it may be possible to develop suitable abbreviations.

The examples put together in the accompanying table give an idea about the system suggested.

Description of the Iron		Proposed Cast Iron Designation
Mode of Excess Carbon	Matrix	
Flake graphite	Ferritic	Folio-graphito-ferritic
Flake graphite	Pearlitic	Folio-graphito-pearlitic
Flake graphite	Acicular	Folio-graphito-acicular
Flake graphite	Martensitic	Folio-graphito-martensitic
Nodular graphite	Ferritic	Sphero-graphito-ferritic (Nodulo-graphito-feritic)
Nodular graphite	Pearlitic	Sphero-graphito-pearlitic
Temper carbon	Ferritic	Floccu-graphito-ferritic
Temper carbon	Pearlitic	Floccu-graphito-pearlitic
Carbide	Pearlitic	Carbido-pearlitic

Erik O. Lissell, *Res. Dir.*
Sveriges Mekanforbund
Stockholm, Sweden

Albert De Sy

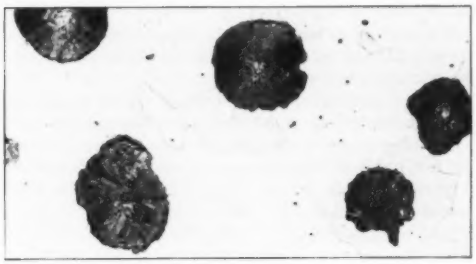
A P. Gagnebin

Nodular graphite is an old, well-known form of graphite in the United States, and the handbooks[1,2] describe it as temper carbon. According to the handbooks, temper carbon, or nodular graphite, forms during annealing and is not present immediately after solidification. A typical nodule of temper carbon is shown in Fig. 6, which demonstrates the well-known fact that it consists of an aggregate of fine flakes intermixed with iron.

The spheroidal graphite particles shown in Fig. 7 represent the form of graphite obtained in the new

Fig. 6—(left) Nodular graphite in malleable iron. X250.

Fig. 7—(below) Spheroidal graphite in magnesium-treated iron. X250.



magnesium-treated iron. This spheroidal graphite consists of polycrystalline-appearing, radial-structured spheroids which are formed during the solidification of the iron. Spheroidal graphite occurring in the new magnesium-treated iron differs markedly from nodular graphite in its mode of formation, appearance and structure. Consequently, we are of the opinion that it would be an error to identify the spheroidal form of graphite with the same name as that applied to the nodular form of graphite.

Both Webster and Funk & Wagnall describe nodular as pertaining to "a rounded, irregular mass," which seems to us to be an accurate description of the graphite shown in Fig. 6. A spheroid is defined as "a body having a form nearly like a sphere," and since this harmonizes with the general shape of the graphite particles shown in Fig. 7, it has been our custom to refer to the graphite in magnesium-treated iron as "spheroidal graphite."

We feel that the new graphite form should be called "spheroidal" because this term describes its shape accurately. Furthermore, this graphite form should be distinguished from the old familiar types of graphite, such as flake and nodular.

A suitable name for the product presents different problems. Alloys are sometimes described in terms of their compositions, structures or properties. We have always preferred functional names, i.e., names describing a use or property. We have applied this principle in connection with magnesium-treated iron and suggest "ductile cast iron" as a suitable name.

C. K. Donoho

Erik O. Lissell

1. *American Malleable Iron*, 1944 edition; Glossary, p. 248, "Temper Carbon—Carbon in Nodular Form;" photomicrograph shown on p. 184, Fig. 3.

2. Cast Metals Handbook, 1944 edition, American Foundrymen's Society.

A. P. Gagnebin, *Met.*
The International Nickel Co., Inc.
Bayonne, N. J.

We prefer the term "nodular graphite cast iron" for the following reasons:

1. The first public announcement of this material was made by H. Morrogh and co-workers in reporting work sponsored by the British Cast Iron Research Association. They used "nodular graphite cast iron" as the generic term for the irons produced by the cerium treatment. Magnesium treatment produces essentially the same graphite modification as the cerium treatment and certainly does not warrant different terminology. We feel strongly that the right of priority in nomenclature should be observed and the terminology used by Morrogh et al should be continued.

2. The term "nodular" to describe the graphite modification in either cerium or magnesium treated cast irons is quite accurately descriptive. "Nodule" is defined as "a small roundish lump of some mineral aggregate" (Webster's International Dictionary—Unabridged—2nd Ed.—1945). In other meanings there is definitely connoted in the word nodule the idea of a structure built up about a central nucleus.

Of course, there are nodules in these materials which mineralogically would be classed as spherulites, but at the same time there may be flake aggregate nodules. As an accurate description of the material under discussion, the generic term "nodular graphite cast iron" is exact and logical.

Charles K. Donoho, *Chief Met.*
American Cast Iron Pipe Co.
Birmingham, Ala.

We prefer the name "nodular iron castings" for the following reasons:

1. Graphitic carbon in this new type of casting is usually in the form of nodules. Quite often the carbon

E. K. Smith

W. W. Austin, Jr.

is in true "spheroidal" form, but not always. The following definitions, from Webster's dictionary, distinguish the various shapes: Node—A knot, a nob. A point at which subsidiary parts center: Nodule—A rounded mass of irregular shape: Nodular—Pertaining to, characterized by having, or in the form of, nodules: Spheroid—A figure like a sphere, but not spherical.

It would seem that the term "nodular" covers quite accurately the shapes of the graphite in the new irons. A study of the micrographs in published articles would

Fig. 8—Graphite forms in Mg-Cu treated iron. Unetched. X 1000.

make Webster's definition especially applicable when one includes all the graphite forms in nodular castings, and not simply the forms which are "spheroidal."

The micrograph (Fig. 8) shows two adjacent forms of graphite in iron treated with magnesium-copper, which tested 109,000 psi as-cast. One might be called a "nodule," the other a "node," and the casting could properly be described as "nodular."

2. As "nodular iron" was introduced to the world by H. Morrogh in his many publications, there would seem to be justice in following Morrogh's "nodular" nomenclature, particularly as it describes the general graphite forms so well.

3. We prefer the term "nodular iron castings" to Morrogh's "nodular cast irons." Morrogh's title infers that the new product is "cast iron." The new product is quite distinct from cast iron and to our mind should not be coupled with cast iron in nomenclature.

E. K. Smith, *Consulting Met.*
Los Angeles

The terminology introduced by H. Morrogh in his paper "The Production of Nodular Graphite Structures In Cast Iron," *Journal*, Iron and Steel Institute, vol. 158, March, 1948, pp. 306-322 adequately describes and defines the various forms of carbon occurring in cast irons. Accordingly, the term "nodular graphite" signifies the occurrence of free carbon in spheroidal or spherulitic particles either in annealed malleable iron or in specially treated (cerium, magnesium, etc.) cast irons.

To distinguish between "spheroidal" and "spherulitic" nodules, it is pointed out that spheroidal nodules are imperfectly formed (irregular or ragged appearing) spheres of graphite such as are observed in annealed malleable iron when its sulphur content is predominantly in the form of MnS. The alternative term "graphite flake aggregate" type of nodule has also been used to designate this form of carbon.

On the other hand, "spherulitic nodules" are exemplified by the more nearly perfectly spherical graphite particles occurring in annealed malleable iron when its sulphur content is predominantly in the form of FeS. In this connection it is pointed out that the nodular graphite occurring in cerium- and magnesium-treated irons is usually of the spherulitic variety. These particles are characterized by markedly smooth spherical outlines in contrast to the ragged appearance of temper carbon nodules in normal American blackheart malleable iron.

In view of these facts, the writer believes that the term "nodular cast iron" is more comprehensive and hence best suited to the description of those specially treated (cerium, magnesium, etc.) irons whose carbon is predominately in the form of spherulitic nodules as-cast.

Wm. W. Austin, Jr., *Met.*
Southern Research Institute
Birmingham, Ala.

Must Not Assume Test Bar Values Can Be Found Throughout Casting

MECHANICAL PROPERTIES obtained from standard separately cast test bars must not be assumed to be the properties actually existent in all the parts of the casting! This warning was sounded in a recent report of the Aluminum and Magnesium Division's Test Bars Committee headed by David Basch, Almin, Ltd., of Great Britain, Schenectady, N. Y.

Test bar molds have been designed, the report states in part, to yield optimum reproducible strength values and to reflect any objectionable deviation from required composition, adequate metal handling practices, or heat treatment that may have occurred during production. When such specimens are poured with the casting and accompany it through subsequent metallurgical operations, they provide a check on the quality of the metal.

The mechanical strength of the casting itself depends on the number of factors not met with in the test bar to a corresponding degree—which influence the solidification rate of the metal in the mold and thereby affect the mechanical properties—such as section thicknesses, gating, risering, chilling, permeability and moisture content of the sand.

TRENDS *in* ALUMINUM CASTING ALLOYS

Walter Bonsack
Director of Laboratories
Apex Smelting Co.
Cleveland — Chicago

Presented at the 23rd Annual Foundry Congress, in Paris, Oct. 10-11, 1949, the Official Exchange Paper of the American Foundrymen's Society to the French Technical Foundry Association has for its subject the development of aluminum casting alloys, their properties, heat treatment, and applications in sand, permanent mold, and die casting. The trend toward alloy composition changes has been hastened by economic factors—many of the alloys developed are derived directly from available scrap.

CASTING ALLOYS OF ALUMINUM are used in ever increasing amounts. This increase is due to several factors. With time the structural and economic value of this metal has been more and more recognized, and more engineers and foundrymen have become acquainted with the metal. But also, the introduction of newer alloys and the evolution which older alloys have gone through made the metal easier to handle in the foundry. The expansion of the use of aluminum in die casting is a typical example. Aluminum alloys are cast mainly in sand, permanent mold and die casting, but increasing quantities are being consumed by other casting processes such as plaster molding, centrifugal and investment molding.

Early American alloys were like the European, the aluminum-zinc-copper alloys. However, since these alloys are inherently hot short they soon lost their standing in favor of the aluminum-copper alloys.

New Alloys Developed

For many years the 8 per cent copper alloys represented the bulk of aluminum casting alloys. For aluminum pistons and bearings 10-12 per cent copper alloys were used extensively. With the discovery of heat treatment the 4 per cent copper alloy was introduced. Aluminum-silicon alloys began to appear gradually; 13 per cent and also 5 per cent were the common casting alloys of this series. The addition of magnesium to these latter alloys made them heat treatable and more useful. So at the end of the 1920's there were two distinct groups of aluminum casting alloys—the aluminum-copper alloys and the aluminum silicon alloys.

The use of silicon alloys gradually increased because they are considerably less hot short and have much better casting characteristics than either the aluminum-zinc-copper or the aluminum-copper alloys. However, they presented a change in foundry technique and machining properties and therefore the 8 per cent copper was still the favorite alloy for most common castings.

Silicon alloys were particularly suited for die castings because of their lack of hot shortness and their high fluidity, and it can safely be said that they were the basis for increased production of die castings.

It may be said that with the knowledge of hot shortness in copper alloys and the lack of hot shortness in silicon alloys, it was pure logic to combine the two and produce a more nearly ideal casting alloy. This may have been the case, or it may have happened that the two alloys or the scrap of the two alloys became mixed accidently. The fact remains that by adding silicon to copper alloys better fluidity was gained and hot shortness decreased with the increase in silicon content. This evolution, of course, was not spontaneous, and even after the facts were recognized the acceptance of these alloys was very slow.

First, the permanent mold caster realized the advantages of the silicon addition and specified alloys containing silicon. It enlarged the field of his activity considerably. Silicon was added to the 8 per cent copper (Curve A, Fig. 1), and also new alloys ap-

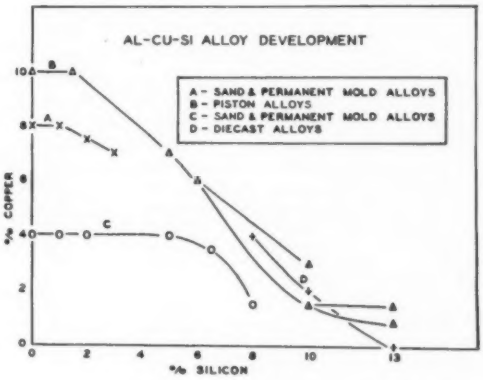


Fig. 1—Tendencies in development of Al-Cu-Si alloys.

TABLE 1—TYPICAL PROPERTIES OF ALUMINUM CU-SI ALLOYS AS-CAST

		Sand Cast		Permanent Mold Cast		Die Cast	
Cu, %	Si, %	Tensile Strength, psi	Elong., %	Tensile Strength, psi	Elong., %	Tensile Strength, psi	Elong., %
4	1 max.	22,000	3.0	—	—	—	—
4	2	—	—	30,000	2.5	—	—
4	3	24,000	2.5	27,000	3.0	—	—
4	5	22,000	2.0	28,000	2.0	40,000	5.0
3.5	6	27,000	2.5	33,000	3.5	—	—
4	8	26,000	2.0	32,000	2.5	45,000	2.5
2	8	27,000	2.5	32,000	2.5	—	—
3.8	12	—	—	—	—	46,000	1.0
—	12	—	—	—	—	39,000	2.0

peared containing 4 per cent copper and 2, 3, and 5 per cent silicon. Figure 1 gives an indication of the tendencies which were developed. For example, the 10 per cent copper alloys were the original piston alloys. They suffered from nearly the same lack of hot strength as the 8 per cent copper alloy. Again, silicon additions gave superior casting alloys.

At first up to 2 per cent silicon was added with good success, but later larger additions improved castability and incidentally also reduced the thermal expansion. To compensate for the rapid increase of hardening by the larger silicon addition, logically the copper had to be reduced. The evolution was therefore 10 per cent copper-2 per cent silicon, 7.5 per cent copper-5 per cent silicon, and finally 6 per cent copper-6 per cent silicon (Curve B, Fig. 1). Aluminum piston alloys containing still higher silicon will be discussed later.

This tendency had been established before the last war. The smelters of aluminum scrap have contributed considerably to the economic utilization of the ever increasing amount of industrial and domestic aluminum scrap. The effects of the most common alloying elements had been studied carefully.[1] The proper balancing of these elements, even in minor amounts, for good casting alloys had been established fairly well, and when the scarcity of commercially pure aluminum and the abundance of aluminum-copper alloy scrap from airplane production during the war forced greater use of copper-containing aluminum alloys, the smelting industry was well prepared.

Duralumin scrap was the main source of raw material for casting alloys. Since it contains 4 per cent copper, only the excess magnesium had to be removed and silicon added to suit the casting process in question. Four per cent copper-2 to 3 per cent silicon was used for heat treatable permanent mold castings; 4 per cent copper-3.5 per cent silicon for general sand castings, and 4 per cent copper-5 per cent silicon for permanent mold and die casting.

An alloy containing 3.5 per cent copper and 6.0 per cent silicon was later developed, an excellent sand and permanent mold casting alloy which is also heat treatable and developes very good properties. Just before the war a similar alloy but with lower copper and higher silicon had been introduced. This alloy contains 1-2 per cent copper, 8 per cent silicon and some magnesium for heat treatability.

In the die casting alloy field the trend was somewhat of the same order. As stated, pure aluminum was not available for the high silicon alloys. Copper-bearing raw materials had to be used. This resulted in the development of alloys containing 10 per cent silicon-2 per cent copper, 9 per cent silicon-3 per cent copper, and 8 per cent silicon-4 per cent copper. These latter alloys have now become the bulk of the die casting alloys. They not only have excellent casting properties but also better machining qualities than the original 13 per cent silicon alloy. The Curve "D" in Fig. 1 indicates this trend.

In all of these alloys it appears that the economic picture has demanded the change in alloy composition.

TABLE 2—COMPOSITION AND PROPERTIES OF SAND CAST AND PERMANENT MOLD CAST SC 8 AND SC 9 ALLOYS

Composition

Alloy	Cu	Fe, max.	Si	Mn, max.	Mg, max.	Zn, max.	Ti, max.	Ni, max.	Others, total
SC 8	3.3-4.3	1.0	5.5-7.0	0.5	0.1	1.0	0.2	0.3	0.5
SC 9	3.0-4.5	1.2	5.5-7.0	0.8	0.5	1.0	0.2	0.5	0.5

Typical Properties — Sand Cast

Heat Treatment*	Alloy SC 8 Tensile Strength, psi	Alloy SC 8 Yield Strength, 0.2%	Alloy SC 8 Elongation, %	Alloy SC 8 Hardness Brinell, 500 kg load	Alloy SC 9 Tensile Strength, psi	Alloy SC 9 Yield Strength, 0.2%	Alloy SC 9 Elongation, %	Alloy SC 9 Hardness Brinell, 500 kg load
As-Cast	27,000	16,000	2.5	65	28,000	16,000	2.0	70
T-4	38,000	28,000	3.0	90				
T-6	35,000	24,000	3.5	85	36,000	24,000	2.0	80
T-7	39,000	30,000	1.5	90				
T-51	29,000	18,000	2.0	70				
Permanent Mold Cast								
As-Cast	33,000	19,000	3.0	70	34,000	19,000	2.5	85
T-4	41,000	23,000	4.5	90	40,000	27,000	3.0	95
T-61	50,000	42,000	1.5	100				
T-51	37,000	25,000	2.0	70				
T-7	40,000	24,000	4.0	90				

* See Table 3 for heat treatment designations.

This is partially true; the pressure was in this direction, but it has only speeded up the acceptance. The development was going very certainly in this direction. The better castability was the basic factor. However, the physical properties are also quite attractive to the designing engineer.

Table 1 shows a few of the properties of the alloys discussed in the foregoing. This table also indicates in which type of casting method they are used.

Casting Method Affects Tensile Strength

It is interesting to note that the tensile strength in sand casting alloys ranges from 22,000 to about 27,000 psi, and the elongation centers around 2.5 per cent. By casting these alloys into permanent molds higher strength and equal or better ductility is obtained; die casting gives still better strength. It should particularly be noted that the 12 per cent silicon alloy die cast has generally lower properties than the copper-bearing lower-silicon alloys.

An alloy which has been greatly used since the war is that containing 3.5 per cent copper-6 per cent silicon. It was developed during the war. Considering its two main alloying elements only, it should not show any exceptional properties. However, as in most of these aforementioned alloys, a control and balance of the other alloying elements present determines not only the casting, but also the other physical properties. Tichy[2] reported on the development of this alloy in 1946. This alloy and a similar one were later incorporated in the ASTM *Specifications B 26-48T* and *B 108-48T* as Alloy SC 8 and Alloy SC 9, respectively.[3]

The difference between these two alloys is not too obvious (Table 2). It should be pointed out therefore that alloy SC 8 is considerably more closely controlled in the alloying elements, copper, iron, manganese, and magnesium. Magnesium particularly is held to a low limit in order to give the alloy greater ductility. As it is known that magnesium causes age hardening even at room temperature, alloys with magnesium higher than 0.15 per cent lose ductility at a fairly rapid rate.

However, by keeping the magnesium to such low limits as in alloy SC 8 the danger of embrittlement is well removed while yet retaining sufficient magnesium to produce response to heat treatment, good yield strength, and a minium lowering of ductility. The closer control of copper also adds to these factors. The manganese is balanced against the iron to prevent the ill effects of high iron on casting properties. Thus an alloy has been produced which equals or even betters some of the older heat treatable casting alloys.

The heat treatment designations used in the tables and tests are based on the following scheme adopted in the United States:

T-4: Alloy solution heat treated and quenched.

T-5 (T-51): Artificially aged casting without previous solution heat treatment.

T-6 (T-61, etc.): Solution heat treated and artificially aged.

T-7: Solution heat treated and then stabilized at elevated temperatures.

The temperatures and time used in the various heat treatments change, of course, with the various alloys and with the size of the castings, the mode of fabrication, and the properties desired. Most common treatments are given in Table 3.

A similar alloy but with lower silicon consists of 4 per cent copper-3 per cent silicon specified by ASTM as Alloy CS5.[3] Its composition and physical properties are given in Table 4. This alloy is used in sand and permanent mold casting in preference to the older no. 12 alloy or 8 per cent copper. It is also heat treatable. Zinc in this alloy is usually limited to 1.0

Table 3—Common Heat Treatments

Alloy	Treatment*	Solution Treatment Temp., C	Solution Treatment Time, hr	Aging Treatment Temp., C	Aging Treatment Time, hr
CS 5; SC 8 & SC 9	T-4	500-510	4-12	—	—
CS 5; SC 8 & SC 9	T-6	500-510	4-12	145-155	2-6
CS 5; SC 8 & SC 9	T-7	500-510	4-12	220-235	7-9
CS 5; SC 8 & SC 9	T-51	—	—	220-235	7-9
SC 12	T-4	505-516	4-12	—	—
	T-6	505-516	4-12	145-155	3-5
	T-61	505-516	4-12	145-155	12
	T-7	505-516	4-12	220-235	8
	T-51	—	—	220-235	7-9
34; 66; Red X-10; Red X-13; Red X-20	T-52	—	—	195-205	8

* T4—Solution heat treated and quenched.
T5 (T-51)—Artificially aged without previous solution heat treatment.
T6 (T61, etc.)—Solution heat treated and artificially aged.
T7—Solution heat treated and then stabilized at elevated temperatures.

Table 4—Composition and Properties of CS 5 Alloy

Alloy	Cu	Si	Mg, max.	Zn	Fe, max.	Mn, max.	Ni, max.	Others (each)
CS 5	3.5-4.5	2.5-3.5	0.05	1.0 (1.0-2.0)	1.0	0.6	0.3	0.8 max.

Heat Treat	Tensile Strength, psi	Yield Strength, 0.2%	Elongation, %	Hardness Brinell, 500 kg load
Typical Properties — Sand Cast				
As-Cast	24,000	14,000	2.5	60
T-4	30,000	18,000	4.0	65
T-6	36,000	26,000	1.5	85
T-51	28,000	21,000	1.5	75
Permanent Mold Cast				
As-Cast	27,000	16,000	3.0	65
T-4	39,000	18,000	5.5	90
T-6	40,000	26,000	4.0	85
T-51	35,000	28,000	1.0	80

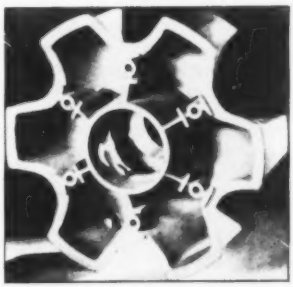


Fig. 2—Aluminum alloy truck trailer wheel was cast in a permanent mold—one of the many heavy-duty applications.

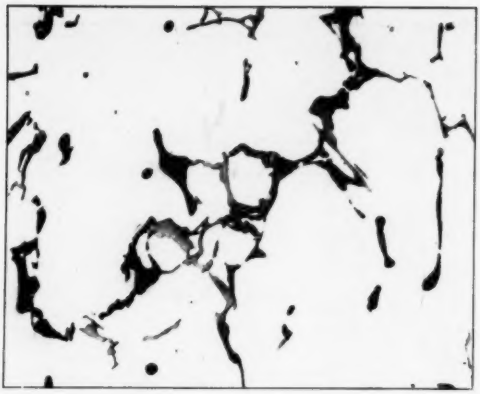


Fig. 3—Microstructure (above) of alloy CS 5 (4 per cent copper-3 per cent silicon) before heat treatment. Chill cast; etched in 25 per cent nitric acid. 200X. Right—typical casting made of the CS 5 aluminum alloy.

per cent maximum, but good results have been obtained with up to 2.0 per cent zinc.

The structure shown in the photomicrograph of Fig. 3 gives the constituents of the alloy before heat treatment. Mainly visible is the black aluminum-copper compound, the gray silicon crystals, and in fine needle form the aluminum-iron complex. During solution heat treatment most of the copper compound will go into solid solution and will not be visible.

A third type of alloy which has been used successfully during the past 10 years, built up from the same raw materials, contains 1.5 per cent copper and 8 per cent silicon, and is known as SC 42. In its composition manganese and magnesium are closely controlled within given limits to assure the properties. The high silicon content assures good castability in sand as well as in permanent molds for complicated castings. During the war it was used for V-8 tank engines (Fig. 4).

Cylinder blocks, crank cases, cylinder heads and other auxiliary castings were made from this alloy. Its composition specification and typical properties are given in Table 5, and the properties are quite flexible due to the heat treatability of the alloy.

By increasing the silicon content of SC 42 alloy, and varying the magnesium and manganese contents various low-expansion piston alloys have been produced. During the war even the copper content was raised somewhat with no deleterious effect. The composition of these alloys and the physical properties are given in Table 6.

Of these three low-expansion piston alloys the first is the one most used, in spite of the fact that it has the highest expansion. The reason for this is its excellent castability as compared to the other two, and better machinability.

Figure 5 shows the typical microstructure of a permanent mold cast red X-10 alloy. It is of the same order as the alpax alloys showing aluminum dendrites in a matrix of aluminum-silicon eutectic. The dark needle-like component is the iron complex compound, while the "Chinese script" like crystals are the manganese-iron-silicon complex compounds. Copper is

TABLE 5—SC 42 ALLOY—COMPOSITION AND PROPERTIES

Composition								
Alloy	Cu	Si	Mg.	Zn, max.	Cr, max.	Fe, max.	Mn	Others (each)
SC 42	1.0-2.0	7.0-8.5	0.2-0.6	1.0	0.3	0.8	0.2-0.8	0.2 max.

Properties — Sand Cast				
Heat Treat	Tensile Strength, psi	Yield Strength, 0.2%	Elongation, %	Hardness Brinell, 500 kg load
As-Cast	27,000	16,000	2.5	60
T-4	33,000	20,000	2.5	80
T-51	30,000	21,000	1.5	70
T-6	37,000	25,000	2.5	85
T-61	42,000	37,000	1.0	90
T-7	36,000	28,000	2.0	80
Permanent Mold Cast				
As-Cast	32,000	19,000	2.5	70
T-4	40,000	21,000	5.0	80
T-51	36,000	28,000	1.0	90
T-6	44,000	27,000	4.0	85
T-61	49,000	40,000	2.0	90
T-7	41,000	28,000	3.0	85

By increasing the silicon content of SC 42 alloy, and varying the magnesium and manganese contents various low-expansion piston alloys have been produced. During the war even the copper content was raised somewhat with no deleterious effect. The composition of these alloys and the physical properties are given in Table 6.

TABLE 6—LOW EXPANSION PISTON ALLOYS

Composition								
Alloy	Cu	Si	Mg	Zn, max.	Fe, max.	Mn	Ni	Others (each)
Red X-10	1.0-2.0	9.5-10.5	0.4-1.0	0.6	0.8	0.5-0.9	—	0.2 max.
Red X-13	1.0-2.0	11.0-13.0	0.4-1.0	0.4	0.9	0.5-0.9	—	0.2 max.
Red X-20	1.0-2.0	19.0-22.0	0.4-0.8	0.5	0.9	0.2-0.6	0.3-1.0	0.2 max.

Typical Properties						
Alloy	Heat Treat	Tensile Strength, psi	Yield Strength, 0.2%	Elongation %	Hardness Brinell, 500 kg load	Coefficient Thermal Expansion*
Red X-10	(T-52)	40,000	34,000	0.5	95	20.9
Red X-13	(T-52)	40,000	32,000	0.5	100	20.1
Red X-12	(T-52)	30,000	—	—	110	17.8

* 10^{-6} in./in./°C

in solid solution and not visible in the structure.

With increase of silicon the expansion of the alloy is lowered, as indicated in the last column of Table 6, but at the same time the thermal conductivity is also lowered. By lowering the conductivity the piston will naturally run hotter in the engine, and the advantage gained by lowering the expansion is greatly lost due to higher operating temperature.

The high silicon gives excellent bearing surfaces, but makes the casting more difficult to machine. Also, alloys containing 20 per cent silicon require high pouring temperatures, which slows production considerably. All the factors discussed must be considered under our mass production methods, and if these factors do not add up favorably, no matter how good the alloy it will be used only in limited specific applications. This is the case with the 20 per cent silicon alloy.

Since the war another piston alloy has found large application. The alloy known as 34 or D 132 is also based on the utilization of airplane scrap, but in this case, engines. Its composition and typical properties are given in Table 7.

Although the specification is rather widely written, in actual practice it is kept much closer to allow control of castability and also of properties. It is used in competition with the 6 per cent copper-6 per cent silicon alloy at present, although the latter alloy is

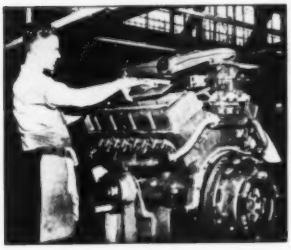


Fig. 4—Complicated castings, such as those on the V-8 tank engine shown during assembly, are cast in the high-silicon aluminum SC 42 alloy.

easier to cast and to machine. (The 6 per cent copper-6 per cent silicon alloy is also used in France.) The properties of both alloys are closely comparable or even better for the 6 per cent copper-6 per cent silicon alloy, as shown in Table 7.

The structure of this alloy (Fig. 6) is very similar to that of alloy SC 5 shown in Fig. 3, only the copper compound is present in large amounts. Since the copper content is greater than the limit of solid solution, considerable amounts of copper will be visible even after solution heat treatment. This copper compound contributes materially to the bearing quality of the piston alloy.

In the same family of alloys belong the die casting alloys previously mentioned; the 4 per cent copper-5 per cent silicon, 4 per cent copper-8 per cent silicon, and 2 per cent copper-10 per cent silicon alloys. The 4 per cent copper-8 per cent silicon alloy is the most widely used, and the 4 per cent copper-5 per cent silicon, although the oldest, is used the least. The ASTM *Specification B 85-48 T* specifies the composition limits for this alloy as shown in Table 8.

Two alloys are specified for two different uses. The

TABLE 7—PISTON ALLOYS 34 OR D132, AND 66

	Composition							
Alloy	Cu	Si	Mg	Zn, max.	Fe, max	Mn, max.	Ni	Others (each)
34	2.0-4.0	8.5-10.5	0.5-1.5	0.5	1.2	0.5	0.5-1.5	0.3

	Typical Properties				
Alloy	Heat Treat	Tensile Strength, psi	Yield Strength, 0.2 %	Elongation, %	Hardness Brinnell, 500 kg load
34	(T-51)	36,000	28,000	1.0	100
66	(T-51)	40,000	31,000	1.0	100

lower iron containing alloy for cold chamber, high pressure die casting machines, and the higher iron alloy for gooseneck machines. Although two different zinc limits are given for the two alloys, the zinc has no bearing on the properties, the castability, and the usefulness of the alloy, nor does it conflict with type of die casting machine used, and the differentiation must be disregarded as wholly useless.

The 4 per cent copper-8 per cent silicon alloy has excellent fluidity and is not hot short. It does not solder to the die and has excellent all-around casting qualities. As shown in Table 1, it has good mechanical properties and it machines well. It can be used wherever corrosion is not a problem. An interesting application is shown in Fig. 7.

These castings are for hydraulic pressure pump control valves.[4] The castings must withstand 1800 psi pressure without leaking. This is remarkable since in the past die castings have suffered from a reputation for porosity. But here it is shown that by applying the proper technique and care, with the proper alloy, a reliable, strong casting can be produced by the die casting method.

In contrast to alloys SC 6 and SC 7, a newer series of alloys has been introduced in the past 10 years which attain physical properties of the previously discussed aluminum alloy without necessarily resorting to heat treatment. However, if a solution heat treatment is applied they will develop properties far beyond those of the older or commonly used alloys. These alloys are essentially of the Al-Zn-Mg type.

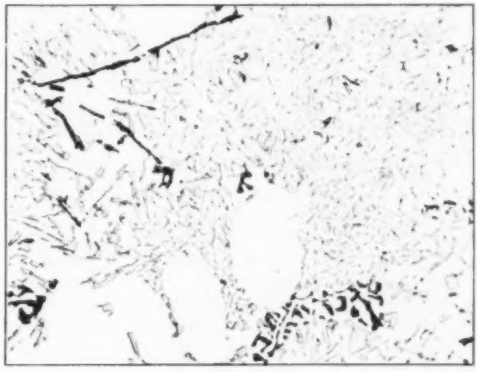


Fig. 5—Typical microstructure of permanent mold cast red X10 aluminum alloy. Etched, 20% H_2SO_4. 250X.

TABLE 8—COMPOSITION LIMITS—ALLOYS SC 6 AND SC 7
(ASTM SPECIFICATION B 85-48 T)

Copper	3.0-4.0
Iron	1.3 or 2.0
Silicon	7.5-9.5
Manganese	0.5 max.
Magnesium	0.1 max.
Zinc	0.6 or 1.0
Nickel	0.5 max.
Tin	0.3 max.
Others (total)	0.5

These alloys as stated develop their high strength by aging at room temperature over a period of several weeks. After casting they usually have very high ductility and lend themselves readily to cold forming, bending or straightening without cracking. Generally speaking, the strength immediately after sand casting is around 30,000 psi and the elongation around 10 per cent. Specifically, the first two alloys have properties as shown in Table 9.

The hardening element in these two alloys is a complex $Al_2Mg_3Zn_3$ compound. The ternalloy 5 alloy does not materially improve with solution heat treatment, while ternalloy 7 alloy can be solution heat treated and high properties obtained. The heat treatment for the latter alloy consists of 4-16 hr at 538 C for solution treatment, and 3-5 hr at 145-155 C aging for T-6 treatment, and 4-10 hr at 170-185 C for the T-7 treatment. However, desirable properties are obtained without treatment, as shown in Table 9.

Both alloys are mostly used in the untreated condition. Heat treatment and heat treating equipment are expensive, and since the alloys possess high properties even without such treatment, they are of particular advantage to foundries which do not have such facilities for processing castings.

The alloys have other desirable properties such as excellent machinability and corrosion resistance. They are dimensionally very stable and do not grow under the influence of heat, as do most aluminum alloys during aging. They take a high polish and are of silver-white color.

Compared to the micrographs of the aluminum-copper-silicon and aluminum-silicon-copper alloys, the structure shown in Fig. 8 appears like one of a pure metal. Only a few particles of highly dispersed compounds of the minor alloying elements are visible. The high solubility of the major alloying elements causes the high strength and high ductility.

With all of these advantages there must, of course, be some disadvantages. There are two which should be mentioned: alloys of aluminum-magnesium, aluminum-zinc, and aluminum-magnesium-zinc are as hot short as the aluminum-copper alloys. Therefore, they are not as easily cast as is the case with the aluminum-copper-silicon alloys.

Special care must be taken to overcome this hot shortness by the usual foundry techniques applied for such alloys. Furthermore, silicon will destroy the high properties of these alloys very rapidly, and care must be taken to prevent silicon contamination in the

Fig. 6—Chill cast alloy 66. Etched, 25% HNO_3. 250X.

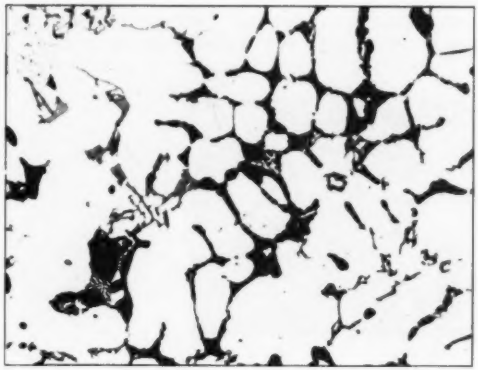


TABLE 9—ALUMINUM, ZINC, MAGNESIUM TYPE ALLOYS

Alloy	Composition Mg	Zn	Mn	Cr	Ti	Cu	Si	(each)
Ternalloy 5	1.4-1.8	2.7-3.3	0.4-0.6	0.2-0.4	0.2 max.	0.2 max.	0.2 max.	0.05
Ternalloy 7	1.8-2.4	4.0-4.5	0.4-0.6	0.2-0.4	0.2 max.	0.2 max.	0.2 max.	0.05
40-E*	0.5-0.65	5.0-6.0	0.3 max.	0.4-0.6	0.1-0.3	0.3 max.	0.2 max.	0.05
Tenzalloy**	0.4	8.0				0.8		

Metals Handbook, 1949, p. 80.

**G. Caminade, *Fonderie*, 32, August, 1948, pp. 1284-5.

Heat Treat	Sand Cast: Tensile Strength, psi	Yield Strength, 0.2%	Elongation, %	Hardness Brinnel, 500 kg load	Permanent Mold Cast: Tensile Strength, psi	Yield Strength, 0.2%	Elongation, %	Hardness Brinnel, 500 kg load
Typical Properties Ternalloy 5								
As-Cast	29,000	13,000	12.0	50	33,000	15,000	22.0	55
After 30 days at room temperature								
	35,000	20,000	8.5	65	43,000	22,000	16.0	70
T-51	30,000	18,000	7.0	60	36,000	21,000	16.0	70
Ternalloy 7								
As-Cast	30,000	19,000	5.0	65	42,000	24,000	11.0	75
T-6	44,000	40,000	1.5	80	49,000	36,000	9.5	95
T-51	38,000	32,000	1.5	80	50,000	44,000	3.0	100
T-7	43,000	38,000	1.5	80	53,000	43,000	6.5	95

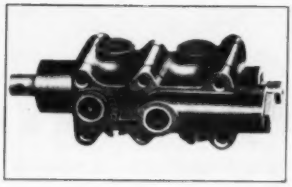


Fig. 7—Die cast in aluminum alloy 66, these castings for hydraulic pressure pump control valves must withstand 1800 psi pressure.

foundry. However, this is just a matter of good housekeeping and should not present an unsurmountable obstacle.

The alloys have been used with excellent success in this country for structural castings, machine tool parts, aircraft fittings and precision instruments where strength and dimensional stability are of prime importance. Due to their advantages, their field of application is ever increasing.

In the preceding discussion the author has tried to give a sketch of the trend of aluminum casting alloys in the United States. It has been shown that aluminum-copper alloys provide good strength alloys to the casting field; however, they lack somewhat on castability. The silicon alloys provide the good castability but lacked the strength and particularly the yield strength of the copper alloys. Combining both groups into a new one, the aluminum-copper-silicon or aluminum-silicon-copper alloys, gave not only good mechanical properties but also desired foundry qualities.

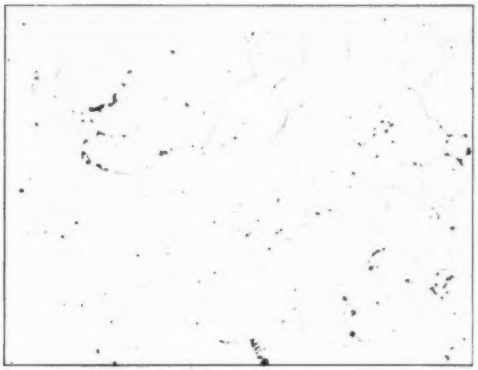


Fig. 8—Microstructure of a chill cast Al-Zn-Mg type alloy (ternalloy 7). Etched, 0.5 per cent HF. 100X.

The only alloy of all these groups which exhibits good ductility and impact strength is the 4 per cent copper alloy, but it had to be solution heat treated. But since it ages at room temperature it will gradually lose its high ductility and join the group of the more common alloys. In all these alloys it is necessary to resort to heat treatment to obtain fairly good ductility.

With the development of the aluminum-zinc-magnesium alloys this has been accomplished to a great extent. Although these alloys are more difficult to cast, the foundrymen have accepted these alloys because they have learned in the last two decades to handle aluminum alloys better, and as their experience increased they had greater success with alloys which were hard to handle 20 years ago.

Conclusion

The alloys and their development discussed in the paper do not by any means constitute all of the alloys used in the United States. However, they include a large part, if not the major part, of the common casting alloys. The older alloys of aluminum-copper and aluminum-silicon alloys are still used for specific castings where one or more of the characteristic properties of the specific alloy makes its application more desirable. Also, the aluminum-copper-silicon and aluminum-silicon-copper alloys shown have many closely related derivations. These, however, do not depart in general nature from the examples.

Development of these alloys has created an ever expanding market for aluminum castings because they are easy to handle in the foundry, give excellent castings which also can be heat treated in various ways. Due to the relatively lower cost of the alloys they are more competitive with other metals. Alloys of the aluminum-zinc-magnesium group are becoming more prominent because they develop highly desirable properties even without heat treatment. It is gratifying to find that many of the alloys discussed are derived directly from scrap and are contributing so effectively to the direct progress of the foundry industry.

References

1. "Discussion of the Effect of Minor Alloying Elements on Aluminum Casting Alloys," American Society for Testing Materials, Bulletin No. 117, Aug., 1942, pp. 45-49, and No. 124, Oct., 1943, pp. 41-51.
2. O. Tichy, "Aluminum Casting Alloy, 3 per cent Cu: 5 per cent Si," TRANSACTIONS, American Foundrymen's Society, vol. 54, pp. 324-330 (1946).
3. American Society for Testing Materials, "Standards on Light Metals and Alloys," Feb., 1949.
4. "Pressure Tight Die Castings," *Die Casting*, vol. 7, no. 8, Aug., 1949, pp. 19-20.

NFA To Hold 51st Annual Meeting In New York City, November 10-11

NATIONAL LEADERS in lawmaking, industry, labor relations and safety education will be featured speakers at the 51st Annual Meeting of the National Foundry Association, to be held November 10-11 at the Waldorf-Astoria Hotel, New York City.

Among the topics to be discussed by these speakers will be the national fiscal policy and its relation to industry, labor legislation and relations, industry public relations, improved production practices, equipment and techniques, cooperation within the industry, and safety practices.

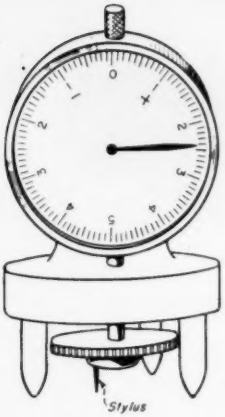


Fig. 1—Direct measurement of surface roughness (at right angles to the plane of the surface) can be made with the surface meter.

How to Measure SURFACE ROUGHNESS OF CASTINGS

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DIMENSIONAL ACCURACY OF CASTINGS is regarded as important by both the foundry and the consumer, but suitable tolerances have not been defined. The tendency is to narrow tolerances on castings for numerous purposes, and complaints of inaccuracies as small as 0.02 in. are not novel. And when tolerances are small, surface finish has an important bearing on measurement.

To evaluate the surface roughness of castings, a simple direct-reading instrument of the stylus type is required together with a classification system for various degrees of surface roughness found in commercially produced castings. A "surface meter" has been developed (Fig. 1) which meets foundry needs and those of customers in that it is direct reading, portable, withstands rough usage, is low in cost and is non-destructive in operation.

The surface meter consists of a tripod support with the contact points machined to $\frac{1}{16}$ in. (with flat bottom) to prevent rocking when placed on the casting, and also to prevent penetration of surface irregularities. The operating disk carries a phonograph needle offset 0.079 in. from center, so rotation of the disk will cause the needle to traverse a circle of $\frac{1}{2}$-in. periphery. Fifty graduations around the disk enable the operator to traverse the needle in 0.01 in. increments. Vertical movement of the stylus is indicated by a dial-gage reading in 0.0005 or 0.0001 in. divisions.

The instrument is held in contact with the casting while the disk is lifted, rotated and lowered progressively from division to division. Dial-gage readings are recorded for the respective increments of stylus traverse.

TABLE 1—TYPICAL RECORDING OF ROUGHNESS DATA
(using random zero on dial-gage)

		R Mean value 9.6	
	1	2	3
Reading Number	Reading inch/1000	Deviation from mean of 9.6	Square of Deviation
1	7.5	2.1	4.41
2	6.5	3.1	9.61
3	8.6	1.0	1.00
4	6.8	2.8	7.84
5	10.1	0.5	0.25
6	15.9	6.3	38.90
7	13.1	3.5	12.25
9	10.4	0.8	0.64
10	7.8	1.8	3.24
40	13.0	2.4	11.46
42	11.6	2.0	4.00
43	7.0	2.6	6.36
44	7.5	2.1	4.41
45	10.5	0.9	0.81
46	11.0	1.4	1.96
47	11.6	2.0	4.00
48	12.4	2.8	7.84
49	10.3	0.7	0.49
50	10.0	0.4	0.16
Sum of Squares (Mean 9.6)			400.89
Mean Square			8.02
Roughness (Root-Mean-Sq)			R2.8

TABLE 2—CLASSIFICATION OF SURFACE ROUGHNESS

Class	Symbol	Range of Roughness H-rms. values in thousandths
O	R¼	Zero to 0.250
A	R½	0.251 to 0.500
B	R1	0.501 to 1.000
C	R2	1.001 to 2.000
D	R4	2.001 to 4.000
E	R8	4.001 to 8.000

By graphical representation it is then possible to produce an enlarged impression of the explored surface. The results are considered typical for the area of the circle described by the stylus. Of course, absolutely identical results will not be obtained if the test is repeated on the same location, but the differences in readings are minute and general characteristics of the surface are unaltered.

Surface-finish measurements are made in terms of the average height (H-ave.) of the crests and roots in relation to a centerline and in terms of root mean square of average height (H-rms.) of crests and roots above or below a centerline. In use of the surface meter, readings of ordinates are taken at 0.01 in. increments and recorded (column 1 of Table 1). Deviations from the mean value are tabulated in column 2. To obtain the root mean square values the deviations are squared (column 3) and the square root of the mean square obtained. In the example, the mean square is 8.02 and the square root or H-rms. is 2.8.

To classify surface roughness in simple terms, the symbol *R* is taken to indicate surface roughness, followed by a number indicating the H-rms. value in thousandths of an inch. Thus, R1.8 denotes an H-rms. value of 0.0018 in.

Ranges in surface roughness can be grouped in six

NOTE: Reprinted from *American Machinist*, July 3, 1947.

classifications that cover all normal ranges of surface roughness presently encountered and also finer surfaces should they be produced in the future. These six classifications are listed in Table 2.

These surface roughness ranges are arranged on a logarithmic basis to provide a smaller range in each class as the roughness decreases. Variations in skin finish will occur at various parts of the casting, but the *R* value will fall within the range; that is, within 50 to 100 per cent of the magnitude of the maximum value. However, when a core is used to form one face of a casting and green or dry sand another face, the two faces should be reported separately. And in reporting a casting the nomenclature will be for example: "R1.2—Class C," the first figure giving the actual surface roughness.

In the case of rougher skin finishes—upward of R1.5—it is not necessary to read and record stylus movement for the 50 increments of traverse. Merely operate the needle in contact with the sample for one complete revolution, meanwhile estimating the mean value of the dial-gage readings. Set the gage zero to this mean value and record dial-gage readings for the various increments of traverse. Square the readings, divide the sum of the squares by 50 and obtain the square root. For finishes up to R1.5, 25 readings will suffice.

Corrosion of Water Pipes Studied

The usual cast-iron water pipes seem to resist corrosive action with cold water flowing through them about as well as the more expensive commercial pipes now available, the National Bureau of Standards concludes from a 10-year experiment reported in *Science News Letter*, Sept. 3, 1949.

The rapidity with which water pipes corrode, and fail, is important information to the home-owner and the building industry. The replacement of corroded pipe usually is an expensive job, often requiring the rebuilding of walls and flooring.

In the Bureau's investigation, tap water of the Washington system, which has a known analysis, was circulated at constant velocity through a system of eight vertical columns, each made up of 14 specimens of commercial pipe lengths. The specimens consisted of two types of cast iron, three of wrought iron, two of ingot iron and three of open-hearth steel. The amount of inside corrosion was determined by loss of weight and the depth of the pits in the materials.

Every precaution was taken in the investigation to assure reliable results. Except for the metal specimens, the water within the apparatus came in contact only with rubber, glass and stainless steel. Hard rubber rings separated the specimens to prevent metallic contact and galvanic action. The outside of the piping was coated with asphalt varnish to prevent outside corrosion and loss of weight.

Failure of any piping material in actual service usually results from perforation of the wall by pitting. The shallowest pits occurred in the centrifugally cast iron, while the sand-cast iron had pits approximately twice as deep. The results of the tests indicate that there is no great difference in the rates of corrosion of most of the wrought iron materials when measured either by the loss of weight or the depth of pitting.

A low-alloy steel had the highest corrosion rate, while a copper-molybdenum ingot iron and a nickel-bearing wrought iron had the lowest rates. Other low-alloy materials such as wrought irons, ingot iron, and ordinary medium carbon steel pipes corroded at intermediate rates. A rough estimate of the minimum life of these bare materials when subject to continuous flow of Washington (D.C.) water would be about 15 years on the basis of the work, the Bureau states.

The tests were made by G. A. Ellinger, L. J. Waldron and S. B. Marzolf of the Bureau staff.

Future Meetings and Exhibits

American Gas Association, annual convention, Palmer House, Morrison, and Sherman Hotels, Chicago—Oct. 17-20.

American Society for Metals, metal congress and exposition, Public Auditorium, Cleveland—Oct. 17-21.

Regional Foundry Conference, Metropolitan, Philadelphia and Chesapeake Chapters of A.F.S., Stevens Institute of Technology, Hoboken, N. J., Oct. 21-22.

National Safety Council, 37th National Safety Congress and Exposition, Chicago, Oct. 24-28.

National Metal Trades Association, annual convention, Palmer House, Chicago—Oct. 26-28.

Gray Iron Founders' Society, annual meeting, Edgewater Beach Hotel, Chicago—Oct. 27-28.

American Society of Tool Engineers, semiannual meeting, Montreal, Canada—Oct. 27-29.

Michigan Regional Foundry Conference, A.F.S. Michigan Chapters, Michigan State College, East Lansing—Oct. 28-29.

Industrial Management Society, annual time and motion study clinic, Sheraton Hotel, Chicago—Nov. 2-4.

Metals Casting Conference, A.F.S. Central Indiana and Michiana Chapters, and Purdue University, Lafayette, Ind.—Nov. 3-4.

Annual Pittsburgh Conference on X-ray and Electron Diffraction, Mellon Institute of Industrial Research, Pittsburgh—Nov. 7-8.

National Air Pollution Symposium, Huntington Hotel, Pasadena, Calif., Nov. 10-11.

National Foundry Association, annual meeting, Waldorf-Astoria Hotel, New York—Nov. 10-11.

New York State Regional Foundry Conference, A.F.S. Upstate New York Chapters, Syracuse University, Syracuse, N. Y.—Nov. 25-26.

Chemical Industries, exposition, Grand Central Palace, New York—Nov. 28-Dec. 3.

Society for Experimental Stress Analysis, annual meeting, Hotel New Yorker, New York—Nov. 30-Dec. 1.

Plant Maintenance Show & Conference, Public Auditorium, Cleveland—Jan. 16-19, 1950.

Birmingham Regional Foundry Conference, A.F.S. Birmingham District Chapter, Tutwiler Hotel, Birmingham, Ala.—Feb. 2-4, 1950.

American Society for Testing Materials, annual committee week, William Penn Hotel, Pittsburgh—Feb. 27-Mar. 3, 1950.

Ohio Regional Foundry Conference, A.F.S. Cincinnati District, Canton District, Northeastern Ohio, Central Ohio and Toledo Chapters, Netherlands Plaza Hotel, Cincinnati—Mar. 10-11, 1950.

Steel Founders' Society of America, annual meeting, Edgewater Beach Hotel, Chicago—Mar. 21-22, 1950.

American Society of Tool Engineers, Philadelphia—Apr. 10-14, 1950.

54th Annual Foundry Congress and Exhibit, American Foundrymen's Society, Public Auditorium, Cleveland. May 8-12, 1950.

PATCHING the CUPOLA

develop air-placement process

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and
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REFRACTORY PRACTICE for cupola operation has been based on three basic techniques or materials:

1. Clay or clay and grog fired in shapes (bricks and blocks).
2. Refractory slabs (stone) occurring naturally.
3. Damp mixtures of clay and silica applied by hand (mud).

The value of bricks or stone depends somewhat upon the technique of handling and the control of drying time. Inadequate drying, careless storage, unnecessary heat shock and use of low quality joint or "laying-up" clay contribute to poor results. However, good techniques are well known and, theoretically at least, the quality of patch is dependent upon the material used. The quality of the material is controlled by the producer.

On the other hand, the use of "mud" is subject to but little control and is not based on adequate knowledge of the materials. Most mixes are rule of thumb and many still belong to the "foundry secret" classifications. Attempts have been made to develop information of value on these materials, but most of this work has proved inadequate simply because patch quality is controlled more by the method of application than by basic material quality.

Proportioning Patch Material

It is easy to understand why "mud" patches have been so widely praised by some and so heartily condemned by others when we consider how these materials are proportioned and applied. In most cases the material is not carefully proportioned. The silica may range from local sand to top quality ganister. Even when using quality ganister, few foundrymen bother to specify any type of grain distribution. They may purchase "¼-in. by down" containing anywhere from mostly ¼-in. to mostly "by down." Local molding sands also vary in grain distribution and usually are low in refractoriness.

Recommended percentages of clay vary from 15 to 70 per cent. Some foundries use 100 per cent "clay" although this material usually is so low in pure clay as to fall in the 15 to 40 per cent range.

Some foundries use low quality clay; others use the best. In some practice one is as good as the other because the rest of the "mud" is of such low quality, or the expansion characteristics of the silica being used demand what would normally be a low strength.

Eliminate Quality Variations

Moisture contents range from 8 to 20 per cent, with most patches somewhere between 12 and 16 per cent. Assuming 15 per cent water, a method must be found for elimination of 300 lb of water for every ton of patch. On a volume basis this means that 3200 gal of steam must be driven off for every cubic foot of patch material. Since the moisture content may vary over a wide range from day to day, it is not surprising that results lack uniformity.

The logical answer to the problem is the development of a mechanical method which will help to put a "mud" patch in position with uniformity of density, composition and moisture. Such a mechanical device must eliminate soft-ramming at times of operator fatigue, and must help control moisture contents within a narrow range. Such a device should reduce or eliminate variations in quality caused by human variables and permit the use of high quality patch materials with maximum success. It should reduce the number of operations in which poor results are obtained with good materials, although it may not permit good results with the use of poor or unsuitable materials.

A mechanical method of handling materials of this type has been developed by changing or modifying equipment used for the air-placement of concrete. The original concrete "guns" were not satisfactory, but one design was found which, after considerable research, could be rebuilt to conform to the demands of cupola patching by air-placement. Further minor refinements are expected, but the principle has been found practical and the machine is now in production.

The principle of air-placement requires dry materials which are handled by air through a conveying hose to the point of patching in the cupola. At that point the ganister and clay are plasticized with water and blown onto the cupola wall at high velocity. The result can be compared with sand-slinging in that high densities and excellent control over thickness and position of the patch can be obtained.

Development of the gun called for (1) maximum hydration of the clay in a short time, (2) automatic high clay percentages at the interface between the old

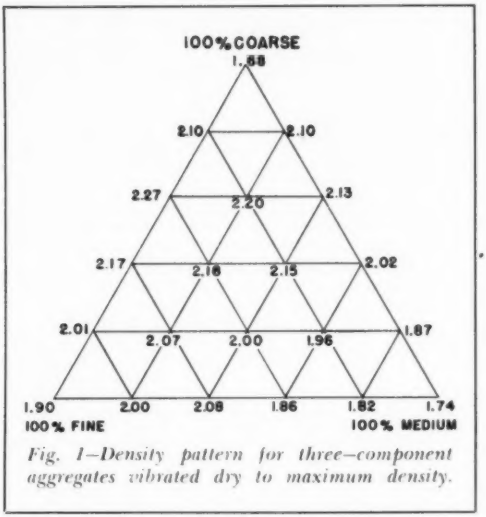


Fig. 1—Density pattern for three-component aggregates vibrated dry to maximum density.

patch and the new, (3) semi-automatic control of moisture and density, and (4) control of velocity and volume.

These developments, although interesting, are not the concern of this discussion. The problem was to determine the best materials for use with the new air-placement method through basic research in the laboratory, in the pilot plant, and in the foundry. Actually this work and the development of the gun were concurrent since each had a bearing on the other. In the same way the three phases of research (laboratory, pilot plant, and foundry) actually overlapped since each one depended upon the other two for guidance. A report of this work in chronological order would be confusing, so each phase of the investigation is discussed individually.

Although it was recognized that most foundrymen do not size their patching materials, it was felt that such sizing should be correct and economical. To determine the initial mixes, work was done on dry densities as related to material size. Dry density could not be duplicated in practice because changes of flowability with moisture would interfere with theoretical maximum results. However, it was necessary to start somewhere.

Figure 1 summarizes the results of this work and indicates that the best theoretical mixture would consist of 60 per cent plus-10 mesh material and 40 per cent of minus-48 mesh material, with no middle sizes. Figures 2, 3, and 4 show the ganisters used. The black squares are ¼ and ⅛ in. South Dakota ganister was not used as the shape of the particles gave poor flow in the air-placement equipment.

The next stage was to prepare a number of combinations of ganisters and clays for testing in the laboratory for workability, density, shrinkage, slag resistance, slump resistance, apparent porosity, and temperature effects. It was necessary to determine whether such tests would correlate with practice and whether they could be used as a method of judging quality of patching materials.

Specimens were prepared by (1) ramming with a laboratory sand-rammer, (2) cutting from a large "patch" rammed against a vertical wall by air-placement, and (3) cutting from a "patch" rammed into a box by hand.

Tables 1 and 2 summarize these tests. Attempts were made to develop an over-all quality index by assigning positive and negative numbers to each test and adding the total. The negative values were made double the positive values on the theory that in practice it would take at least two good features to balance one bad feature.

In Table 2 the final summary shows that these mixes varied extensively in laboratory characteristics, but definite trends were hard to determine. The best mix based on laboratory results contained relatively fine

Fig. 2—Fine Pennsylvania ganister—⅛ in. to dust.

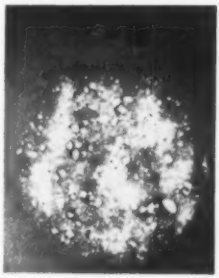


Fig. 3—Rounded southern Ohio ganister—¼ in. to 20 mesh.

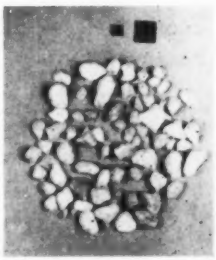


Fig. 4—Wisconsin ganister 3/16 in. to dust. The black squares shown are ¼ in. and ⅛ in.

ganister and Western bentonite. Later work in the pilot cupola showed this mix to rate fifth out of ten, and further work in actual foundry practice classed it as fair. The mixes which later proved to be best in practice were not actually duplicated in the laboratory. This will be explained later.

Materials that appeared to be most dangerous in laboratory tests were Southern bentonite, high water, and low refractory clay. Practical experience confirmed these results.

The two tests of most significance were slump resistance and slag resistance at elevated temperatures. Even so, these tests are only negative. Apparently it is safe to assume that if a patch material shows either poor slump resistance at elevated temperatures or poor resistance to slag penetration, it will not be satisfactory in practice. However, the fact that a material is good on both these characteristics in the laboratory does not indicate it will be satisfactory in practice.

It was concluded that the laboratory tests could be used to discard or eliminate unsatisfactory materials, but that the same tests could not be used to approve materials or determine relative merit. For that reason the mixes that proved best in practice were not later duplicated. The mixes investigated were sufficiently similar to the final product to demonstrate the negligible value of the laboratory tests attempted.

To avoid misunderstanding it must be emphasized that these conclusions do not indicate that laboratory

TABLE 2—SUMMARY OF RESULTS OBTAINED IN LABORATORY TESTS

	Green	Dry		Fired 2750 F				Fired 2500 F		Value		
Mix	Workability	Density	Shrinkage	Slag Resist.	Slump Resist.	Shrinkage	App. Porosity	Density	Slag Resist.	Slump Resist.	Negative	Positive	Total
A	—	p	N	—	—	—	—	—	p	—	−10	+2	−8
B	—	p	—	—	—	—	—	—	p	—	0	+2	+2
C	p	p	—	n	—	n	p	p	p	—	−10	+5	−5
D	p	p	p	—	—	—	—	—	n	—	−5	+3	−2
E	—	p	p	—	—	—	—	—	—	—	0	+2	+2
F	—	p	N	n	—	—	p	p	—	—	−15	+11	−4
G	p	p	p	n	—	p	—	p	—	—	−5	+9	+4
H	N	n	p	—	—	—	—	—	n	—	−20	+5	−15
I	—	p	—	p	P	P	N	—	n	—	−15	+12	−3
J	—	n	p	n	P	P	—	—	n	—	−15	+11	−4
K	—	—	p	—	—	—	—	—	n	—	−5	+1	−4
L	—	p	—	—	—	—	—	—	p	—	0	+2	+2
M	P	—	P	p	—	—	p	—	—	—	0	+12	+12
N	—	—	—	—	—	—	—	p	—	—	0	+1	+1
O	—	p	p	n	—	p	—	—	—	—	−5	+3	−2
P	—	—	—	—	—	n	—	—	p	—	−5	+1	−4
Q	—	n	—	p	n	N	N	N	n	—	−45	+1	−44
R	—	n	—	p	N	—	n	n	n	—	−30	+1	−29
S	—	—	—	n	N	—	—	—	p	N	−25	+1	−24
T	P	—	—	—	—	—	—	—	n	—	−5	+5	0
U	—	N	—	—	—	—	—	—	n	—	−15	0	−15

P = Major positive value (+5) N = Major negative value (−10)
p = Minor positive value (+1) n = Minor negative value (−5)

TABLE 1—COMPOSITION AND GREEN PROPERTIES OF CUPOLA-PATCHING MIXES PREPARED IN THE LABORATORY

		Composition, %					Green Properties			
Mix	Type*	%	Aggregate	%	Binder	Water, %	Workability†	Density, gms/cc	Shear Str., psi	General
A	I	86	Fine Penna. Ganister	14	Pul. So. Ohio Clay	11.0	High	2.27	3.7-4.7	Good daubing mix.
B	I	85	Fine Penna. Ganister	15	Pul. So. Ohio Clay	8.6	Low	2.27-2.29	4.6	Dry for daubing. Good for ramming.
C	I	83	Fine Penna. Ganister	17	Pul. So. Ohio Clay	9.8	34%	2.27-2.30	6.2	Dry for daubing. Wet for ramming.
D	I	60 20	Rounded So. Ohio Ganister Silica Sand	20	Pul. So. Ohio Clay	5.8	16%	2.25-2.29	6.9	Good consistency.
E	B	80	Fine Penna. Ganister	20	Pul. So. Ohio Clay	9.4	Low	2.21-2.33	—	On dry side.
F	B	80	Fine Penna. Ganister	20	Pul. So. Ohio Clay	10.1	High	2.27-2.29	4.7	On wet side.
G	B	60 20	Rounded So. Ohio Ganister Silica Sand	20	Pul. So. Ohio Clay	8.1	35%	2.28-2.34	6.5	Excessive rebound.
H	R	93	Fine Penna. Ganister	7	Southern Bentonite	8.2	Low	1.94-2.33	1.6	Weak, low plasticity.
I	R	88	Fine Penna. Ganister	12	Southern Bentonite	11.7	High	2.25-2.27	3.8	Good mix.
J	R		Proprietary Ladle Daub		As-received	8.0	Low	1.90-2.10	3.7	Spongy feel while ramming.
K	R	60 25	Rounded So. Ohio Ganister Silica Sand	15	Pul. So. Ohio Clay	6.3	Low	1.96-2.24	2.7	High rebound.
L	R	80	Fine Penna. Ganister	20	Pul. So. Ohio Clay	10.0	High	2.22-2.28	5.6	Wet and spongy.
M	R	90	Fine Penna. Ganister	10	Western Bentonite	9.6	30%	2.14-2.18	7.4	Good and solid.
N	B	60 25	Rounded So. Ohio Ganister Silica Sand	15	Pul. So. Ohio Clay	8.3	High	2.21-2.29	4.3	Excessive rebound.
O	B	60 25	Rounded So. Ohio Ganister Silica Sand	15	#12 Mesh So. Ohio Clay	7.9	High	2.19-2.32	4.3	Excessive rebound.
P	B	80	Fine Penna. Ganister	20	#12 Mesh So. Ohio Clay	9.2	Low	2.08-2.16	5.0-6.3	On dry side.
Q	B	90	Fine Penna. Ganister	10	Southern Bentonite	15.1	High	1.95-2.10	2.9	Required high water.
R	B	90	Fine Penna. Ganister	10	Western Bentonite	16.9	High	1.96-2.09	4.6	Required high water, gummed nozzle.
S	B	80	Fine Penna. Ganister	20	Illite Clay	12.0	High	2.10-2.17	4.1-4.6	Very sticky, gummed nozzle.
T	B	60 15 10	Rounded So. Ohio Ganister Silica Sand Silica Flour	15	#12 Mesh So. Ohio Clay	7.9	30%	2.06-2.21	8.0-8.7	Excessive rebound and dusting.
U	B	88	Fine Penna. Ganister	6 6	Western Bentonite #12 Mesh So. Ohio Clay	14.4	High	2.00-2.05	3.5	Gummed nozzle, required high water.

*Type of Mix— I = Individually rammed specimens.
B = Specimens cut from mix applied to vertical wall by air-placement.
R = Specimens cut from mix rammed into closed box with a pneumatic rammer.

†Workability determined by A.S.T.M. Designation C-181-47. High workability = over 38%. Low = specimen shattered or cracked instead of deforming plastically.

TABLE 3—COMPOSITION AND RESULTS OF EXPERIMENTAL LININGS IN 10-IN. CUPOLA

Mix	Composition, %				Water, %	Dry Weight, lb	Loss, lb	Loss, %	Remarks
	%	Aggregate	%	Binder					
V	90	Fine Penna. Ganister	10	Western Bentonite	13.4	329	37	11.2	Good consistency for daubing, too soft for ramming. Soft rammed.
W	60	Rounded So. Ohio Ganister	15	#12 Mesh So. Ohio Clay	8.0	374	49	13.1	Too wet for good ramming mix. Appeared deficient in fines.
	25	Silica Sand							
X	50	Rounded So. Ohio Ganister	20	Pul. So. Ohio Clay	7.1	379	48	12.7	Hard to knock out. Considerable drying shrinkage.
	20	Silica Sand							
	10	Silica Flour							
Y	80	Fine Penna. Ganister	20	Illite Clay	12.3	338	Slumped		Very sticky. Excessive drying shrinkage. Very poor lining.
AA	42	Rounded So. Ohio Ganister	18	Pul. So. Ohio Clay	8.9	362	32	8.9	Moderate drying shrinkage.
	40	Silica Sand							
AB	42	Rounded So. Ohio Ganister	18	Pul. So. Ohio Clay	9.4	341	59	17.3	
	30	Silica Sand							
	10	Ground Coke							
AC	46	Rounded So. Ohio Ganister	10	Western Bentonite	11.4	324	54	16.6	
	44	Silica Sand							
AD	45	¼x⅛ Fine Penna. Ganister	6	Western Bentonite	9.0	350	35	10.0	Hardest to knock out.
	34	Silica Sand							
	15	Silica Flour							
AE	42	Rounded So. Ohio Ganister	18	Pul. So. Ohio Clay	8.6	357	22	6.1	Mixed by hand.
	40	Silica Sand							

tests can not be used to determine the quality of clay or the basic value of an individual material. The authors feel that insufficient knowledge is available to correlate laboratory tests of mixtures for cupola patching with results in practice. Such tests can be used to eliminate mixes that will not work, without guaranteeing that the mixes passing the test will work.

Pilot Plant Research

In actual practice the tests in the foundry were completed before completion of the pilot tests, but the work started was completed to determine how well it checked with service data. The relationship was found to be unusually good and the tests were continued to study materials that might prove dangerous in foundry practice if failure occurred too early in the heat.

Pilot plant tests consisted of running slag tests only in a "baby" cupola (described by D. E. Krause and H. W. Lownie, Jr., "Design and Operation of a 10-inch Cupola," A.F.S. TRANSACTIONS, vol. 57 (1949). The cupola operation was normal except that the charge consisted of silica, limestone and iron oxide in proportions to duplicate normal cupola slags. The cupola design was such that the melting zone could be removed and weighed or measured with laboratory accuracy. Burn-out was expressed as percentage loss in weight of lining.

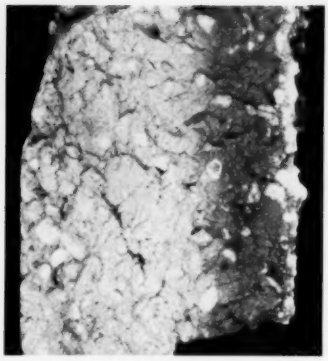
The linings were not put in by air-placement because the cupola dimensions did not permit its use. However, previous work indicated that air-placement gave densities and results comparable to a hand-rammed lining that had been placed with an internal form or shell. Moistures were within the range given by the air-placement equipment and were much too dry for normal daubing or "mud" practice. In some cases the moisture was raised deliberately above 9 per cent to demonstrate the effect of higher water normally used for hand daubing.

Tables 3, 4, and 5 summarize the ten heats made in this series. All heats were normal except heat Y. This lining included 20 per cent illite low fusion clay. The lining slumped and bridged almost immediately. The pressure built up to over 48 oz in 40 min and the heat was discontinued. This heat confirmed the practical work which indicates that low quality patching aggravates cupola bridging. The effect is exagger-

TABLE 4—CHARACTERISTICS OF SECTIONS OF CUPOLA LININGS REMOVED FROM CUPOLA AFTER EXPERIMENTAL HEATS *

Mix and Location*	Color of Dry Lining	Slag Penetration, in.	Depth of ceramic bond, in.	Depth of subsurface porosity, in.	Exposed grains on surface
V-Top	Pink	7/8	7/8	7/8	Many
Middle		1/8	3/4	1/2	Few
Bottom		1/8	7/8	1/2	Few
W-Top	Gray	1/4	1/8	none	Many
Middle		1/8	3/4	none	Many
Bottom		1/2	1	none	Many
X-Top	Gray	1/8	1/2	none	Some
Middle		1/8	1/2	none	Some
Bottom		1/4	1/2	none	Some
Y-Top	Pink	0	0	0	None
Middle		Skin	1/8	7/8	Some
Bottom		1/4	1/2	1 1/8	Some
Z-Top	Gray	1/16	1/2	1/16	Many
Middle		1/8	1/2	3/8	Some
Bottom		3/8	3/4	1/2	Few
AA-Top	Gray	1/16	1/8	1/4	Many
Middle		1/4	1/8	none	Some
Bottom		1/8	1/8	none	Few
AB-Top	Black	Skin	0	1/8	Many
Middle		Skin	1/8	1/8	Many
Bottom		Skin	1/8	1/8	Many
AC-Top	Pink	3/8	1/2	1/2	Many
Middle		1/4	1/2	1/2	Many
Bottom		1/16	1 1/8	3/4	Many
AD-Top	Pink	1/8	1/4	3/4	Some
Middle		1/4	3/8	3/4	Few
Bottom		1/4	3/8	1	Few
AE-Top	Gray	1/8	1/4	1/8	Some
Middle		1/8	1/8	7/8	Few
Bottom		1/8	1/8	3/4	Few

*Bottom location is near lower tuyeres. Middle location is about 18 in. above lower tuyeres and near zone of maximum temperature. Top location is about 36 in. above tuyeres.



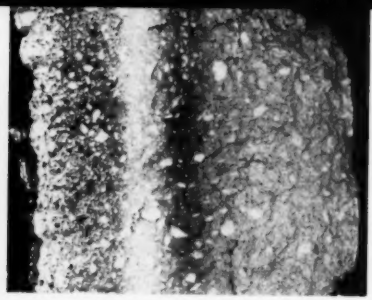


Fig. 6—Radial section, lining Y, middle of tuyere section.

Fig. 5—Radial section, lining AB, bottom of tuyere section.

Fig. 7—Radial section, lining V, top of tuyere section.

ated in a small cupola but indicates the mechanism of bridging in large cupolas using low quality patching materials or inadequate techniques.

Figures 5 through 11 illustrate the various types of formations developed in the cupola patch during the heat. The sections were broken out after the heat to study the appearance, the depth of ceramic bond, the slag penetration and the porosity.

Figure 10 shows the deep ceramic bond of a lining with 42 per cent Ohio ganister, and Fig. 8 the shallow zone obtained with 60 per cent Ohio ganister (Table 3). The requirement for sufficient fines to develop a deep ceramic bond probably accounts for the low life when excessively large material is used. On the other hand, it is evident that when slag penetration exists the fine material is removed first leaving exposed islands of large ganister particles.

Table 5—Evaluation of Cupola Linings in Order of Increasing Amount of Refractory Loss in Standard Heats

Mix*	Refractory Loss† weight, %	lb	sq. in.	Weight of Dry Lining, lb
AE	6.1	22	4.8	357
AA	8.9	32	8.0	362
Z	9.5	35	10.8	369
AD	10.0	35	8.2	350
V	11.2	37	10.0	329
X	12.7	48	12.1	379
W	13.1	49	14.1	374
AC	16.6	54	20.5	324
AB	17.3	59	20.9	341
Y	—	—	—	338

*Composition of linings is given in Table I.

†Refractory loss in square inches refers to area of vertical cross section. With Mix Y, lining slumped excessively and heat could not be run.

Ceramic bond is necessary to stop slag attacks and erosion. Fine material develops ceramic bond. On the other hand, slag attacks the fine particles first, and a lining of all fine material has low resistance to slag attack. Therefore the best lining is a compromise with enough large ganister to minimize slag attack and enough fine material to provide adequate depth of ceramic bond.

Western bentonite develops a deep ceramic bond zone but causes a porosity or honeycomb effect throughout the depth of that zone (Fig. 9). This indicates that small amounts of Western bentonite may be used to develop greater depth of ceramic bond, but excessive amounts may drastically reduce the resistance to abrasion by lowering the density.

Some linings, principally those of low ceramic bond, permit deep slag penetration, while others have little penetration but a high loss of lining. One of the most interesting specimens could not be photographed since it was completely dull black in color. This lining, which contained 20 per cent coke, showed very poor life although slag attack was essentially zero. The only evident reason for the poor life was the complete absence of ceramic bond. The lining was completely soft or "unfired" throughout its depth after 3 hr of operation.

Apparently the low ceramic bond permitted the lining to be eroded or burned away in spite of the minimum slag attack. All the other linings were believed to fail by slag attack, with the possible exception of the bentonite linings which may have failed through erosion or abrasion.

The comparative weight losses listed in Table 5 confirm the indications from a study of the lining sections. Excessively large grains such as those in heats W (Fig. 8) and X prevented deep bond and gave poor life. High porosity such as caused by bentonite resulted in relatively poor life in spite of the depth of ceramic bond (Fig. 9). Silica flour apparently improves the bentonite bonded lining but not enough to permit it to compete with properly proportioned rounded ganister, sand and high quality clay.

The two best linings in the pilot plant tests were

Fig. 8—Lining W, radial section from bottom of tuyere.

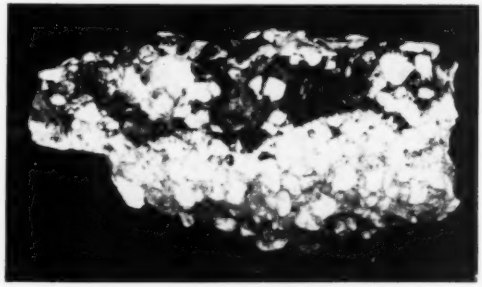
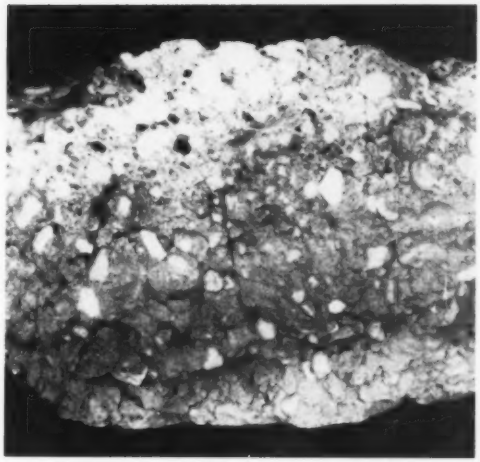


Fig. 9—Radial section, lining AC, tuyere section bottom.



duplicates except for mixing technique. In both cases the lining was made from coarse (¼ in.) rounded southern Ohio ganister, fine (A.F.S. No. 91) clean silica sand, and top quality southern Ohio fire clay in the proportion of 2:2:1 by volume. The better of the two (Fig. 10) was mixed by hand for comparison with the mulled mix used in the air-placement process. Neither lining material was aged.

This work gave excellent correlation with practice and indicated that the "baby" cupola is a practical tool to study lining effects and compare patching materials, at least those of the "mud" type. No comparisons were made against other methods of patching.

Foundry Tests

Through the cooperation of Fulton Foundry & Machine Co., Inc., Cleveland, it was possible to run extensive operating tests with the air-placement process for ramming cupolas with ganister combinations. The complete data covering these tests are listed in Table 6.

Table 6 indicates the screen analysis of the various patching materials together with data on clay content, moisture content and burn-out for each operation. It will be noticed that two types of cupolas were used, namely A and B. These two cupolas are of slightly different dimensions and operate somewhat differently. It is customary for one cupola to show more burn-out than the other, probably because of the high iron oxide content of the charge and the type of scrap being used.

So many variables are encountered in cupola operation that it is difficult to establish definite relationships

Fig. 10—Lining AE, radial section, tuyere bottom. ➡

in any reasonable length of time. For example, in the foregoing tests two cupolas were used and some differences might have been expected. In addition, there were daily variations in the amount of metal melted and in the melting rate per hour. Variations in blast pressure, blast concentration, slag analysis, etc., were expected but could not be measured. In spite of these variations it does seem possible to draw reasonable preliminary conclusions, particularly when these conclusions point in the same direction as prevailing theory.

Our principal interest was in the quality of patch being produced by the air-placement technique. Observations as to the economy of the operation, the saving in time, and the convenience were obvious. The big problem was to definitely determine any improvement in quality and, more important, to determine the best mixes to be used with the air-placement process. For this purpose it was necessary to establish a measure of quality and after some preliminary investigation it became obvious that the best measure was the rate of burn-out per ton of iron melted.

This factor was obtained by making daily measurements of the burn-out from the center line of cupola

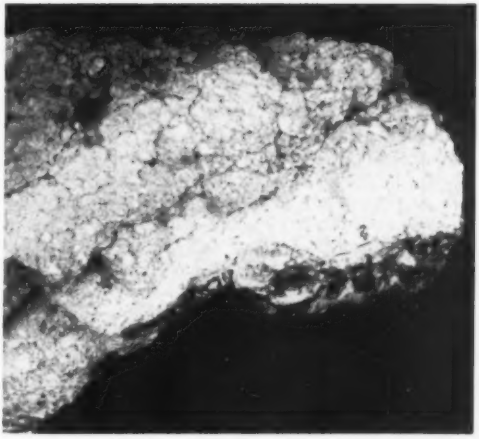


Fig. 11—Radial section, lining V, bottom tuyere section.

Table 6—Operating Test Data With Air-Placement Process of Cupola Ramming

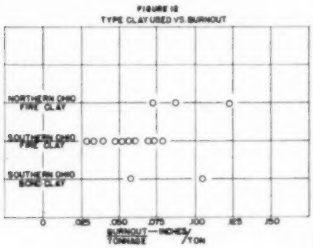
Cupola	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
Patch No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
Heat Date (Feb., 1949)	1	2	3	4	7	8	9	10	11	14	15	16	17	18	21	22	23	24	25
Materials used, %																			
So. Ohio Ganister		62	52	57				57	44	57	44	44	55	57	44	44	44	44	44
Penna. Ganister	75						37		37		37	37			37	37	37	37	37
Silica Sand		20	25	27	29	29		27		27			18	27					
Rebound Material					60	60	44												
Silica Flour													12						
No. Ohio Fire Clay	25	18	23																
So. Ohio Fire Clay				16			19	16	19	16	19	19	15	16	19	19	19	19	19
So. Ohio Bond Clay					11	11													
Screen Analysis of Patch																			
6	4.0	30.0	22.0	22.6	37.0	17.0	18.0	36.0	16.5	26.0	21.0	25.0	38.4	32.0	36.4				
12	12.0	15.0	16.0	17.0	25.0	19.0	14.0	19.0	17.0	19.0	16.0	16.0	22.0	20.0	16.0				
20	15.0	4.0	5.0	4.4	6.0	8.0	10.0	4.0	8.0	5.0	9.0	7.0	3.6	5.0	7.0				
30	9.6	1.0	2.0	1.2	2.0	3.0	5.6	2.0	4.0	2.0	4.0	5.0	1.0	1.0	4.0				
40	7.4	1.0	2.0	1.2	1.0	2.0	4.0	1.0	2.0	1.0	4.0	4.0	1.0	1.0	2.6				
50	6.0	3.0	4.0	3.0	2.0	3.0	4.4	2.0	5.0	3.0	4.0	4.0	2.0	2.0	4.0				
Retained on Screen, % 70	4.0	7.4	8.0	7.2	5.0	8.0	4.4	5.0	6.0	7.0	4.0	3.0	3.0	6.0	2.6				
100	3.0	11.2	11.2	10.8	6.0	11.0	5.0	6.0	9.0	10.0	4.0	3.0	5.0	8.0	2.4				
140	2.0	6.0	5.0	5.6	2.0	6.0	3.0	4.0	5.0	5.6	3.0	2.0	2.0	3.0	2.0				
200	2.0	2.0	2.0	2.6	0.8	2.0	2.0	2.0	2.0	2.4	2.0	2.0	1.0	3.0	2.0				
270	2.0	0.4	0.8	1.0	0.2	1.0	1.0	2.0	1.0	1.0	1.0	2.0	1.0	2.0	1.6				
PAN	10.0	5.0	5.0	3.4	1.0	2.0	9.0	3.0	3.0	2.0	4.0	3.0	4.0	1.0	1.4				
Avg. Grain Fineness	67.0	463	48.1	45.4	20.0	41.6	58.2	35.3	39.2	35.2	40.1	36.1	31.2	31.8	25.5				
Clay, %	23	14	18	20	12	18	20	14	22	16	24	24	16	16	18				
Moisture, %	10.3	9.2	8.7	8.2	8.7	8.5	9.3	7.9	8.4	7.4	9.6	7.8	7.2	8.4	7.3	9.4	7.8	8.2	9.2
Burn-out, In./Ton																			
30 in. Above Tuyeres									.078	.043	.084	.076	.073	.045	.083	.082	.081	.075	.045
36 in. Above Tuyeres	.073	.123	.089	.050	.106	.058	.079	.074	.052	.032	.054	.034	.075	.055	.042	.044	.067	.075	.043
42 in. Above Tuyeres									.023	.020	.041	.026	.058	.040	.021	.055	.044	.063	.048
Length of Heat, hr.	3.88	3.67	3.5	7.5	3.75	4.33	3.83	5.03	3.67	4.75	3.92	4.0	5.3	5.9	4.17	3.57	5.18	4.37	5.85
Melt Total, Tons	37.5	31.5	36.5	65.25	39.0	36.75	39.0	45.75	38.25	43.5	39.0	33.0	54.75	49.5	42.0	33.75	45.0	39.75	42.0
Melting Rate, Tons/hr.	9.8	8.6	10.4	8.7	10.4	8.5	10.2	9.1	10.4	9.15	9.95	8.25	10.3	8.4	10.0	9.45	8.85	9.10	10.7

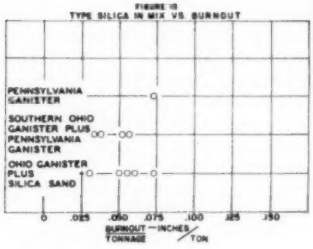
Screen Analysis	So. Ohio Ganister	Penna. Ganister	Silica Sand	So. Ohio Fire Clay	No. Ohio Fire Clay
6	72.0				
12	23.5	9.5			15.2
20	3.8	25.5		13.5	30.0
30	0.3	12.5	0.2	13.5	12.5
40	0.2	9.5	0.3	13.5	9.3
50	0.2	8.0	4.5	13.2	7.5
Retained on Screen, % 70		5.5	20.5	11.3	5.5
100		4.5	40.5	10.0	4.0
140		3.5	22.0	7.0	3.5
200		3.5	7.5	5.0	2.5
270		2.5	2.5	3.0	1.5
Pan		15.5	2.0	10.0	8.5
Avg. Grain Fineness		77.3	84.0	76.0	53.1

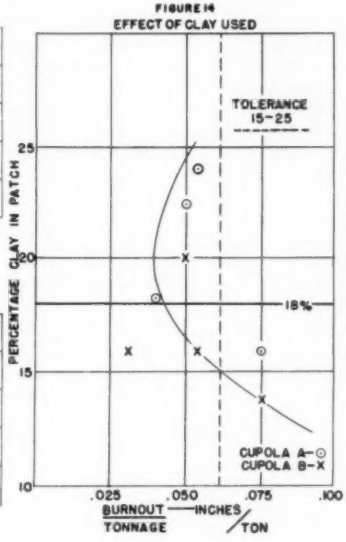
	So. Ohio Ganister	Penna. Ganister	Silica Sand	So. Ohio Fire Clay	No. Ohio Fire Clay
Fusion Point, PCE Cone	33	30	31	31	17
Temperature, F	3173	3002	3056	3056	2669
Physical Properties					
Green Comp., psi				5.18	2.86
Dry Comp., psi				52.0	42.6
Bouyoucos Test					
Sand				12.0	16.0
Silt				25.6	62.0
Clay				62.4	22.0

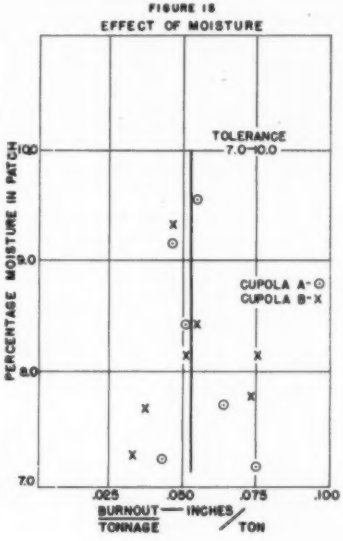
(established by a plumb bob) at eight points around the cupola at levels of 18, 30, 36, 42, 54 and 72 in. above the tuyeres. These measurements were taken before the patch was put in, after patching and after the heat was taken off. Samples of the patch material were removed from the cupola wall each day for moisture and clay content determination, and screen analysis. The fusion points of the materials used and for some of the patching mixes were also determined.

It was immediately evident that measurements at the 18-in. level above the tuyeres did not give a true picture of the burn-out because the daily chipping out of the bridge area affected this particular level. After some preliminary observation it was decided to use the 36-in. level as the most convenient criterion of daily burn-out. This, of course, did permit some









departure from true relationships since there was a tendency in the cupola for the maximum burn-out level to rise or fall, depending upon the operation.

For this reason, if for none other, it could not be expected that attempts to plot the relationship of one factor to another could be extremely accurate. On the other hand, it would be impractical to try to establish complex relationships at more than one operating level. In most cases, the 36-in level seems to be the best.

At the time these tests were started the foundry was using a combination of 75 per cent Pennsylvania ganister and 25 per cent northern Ohio fire clay. Our tests indicated that this material was showing a burn-out at the 36-in. level of 0.073 in. per ton of iron melted. Fundamentally, all subsequent tests were for the purpose of developing an operating practice which would result in less burn-out per ton of melt. The project can be considered successful in that the burn-out rate was decreased and rather definite techniques for obtaining uniform and desired results indicated.

Figures 12 through 18 represent the best correlations to be obtained after attempting some two or three dozen different combinations. These figures indicate surprisingly good correlations and lead to logical conclusions.

The first three runs listed in Table 6 gave an indication that the low fusion northern Ohio fire clay being used was detrimental to the operation. That this conclusion was justified is indicated by Fig. 12, showing the effect of clay quality only. It is apparent from this figure that a good quality, highly refractory and highly plastic clay is necessary for complete success. Previous work would indicate that this same conclusion would be equally true for a hand-patched cupola.

The next series of tests was designed to obtain some indication of the effect of the aggregate material. This seemed desirable from the standpoint of the relatively low refractory value of Pennsylvania ganister, but particularly from the theoretical consideration that maximum size material was necessary. Southern Ohio ganister was used because its rounded shape permitted maximum size without clogging the air-placement gun, and also because it shows the highest PCE value of all ganisters tested. Figure 13 indicates the desirability of using southern Ohio ganister with either fine ganister or sand.

Detailed examination of the data indicates that the best mix was obtained with some sand present. In general, the indications point to the combination of southern Ohio ganister and a fine refractory silica sand as the best possible mix.

From a purely theoretical standpoint, a minimum amount of fire clay is desirable in a ramming mix because fire clay is relatively low in refractoriness, and particularly since it is more readily attacked by slag. On the other hand, some compromise must be made since insufficient fire clay would probably involve a mechanical weakness and detract from patch life.

Figure 14 is based on southern Ohio fire clays only since the northern Ohio clays gave excessive burn-out and would require more clay for the desired results. The relationship is surprisingly good and indicates that fire clay below 15 per cent is undesirable. The optimum percentage of fire clay seems to be about 18 per cent, with no particular harm in going as high as 24 or 25 per cent. These figures apply only to the air-placement process, since more clay and moisture would be required for a hand-rammed lining to provide sufficient plasticity.

In spite of the fact that moisture content is known to be one of the most important factors in a good ganister patch, the work summarized in Fig. 15 indicates that moisture has no effect. We believe that the reason for this is that the moisture contents in all cases in these tests were very low and below the range in which excessive shrinkage, spalling, etc., could be expected.

It must be remembered that even the highest moisture shown in Fig. 15 is only 60 or 70 per cent as high as a hand-daubing "mud." This curve indicates that one mechanical feature of the air-placement gun is that it is almost impossible to use excessive moisture. Excessive water becomes obvious to the operator so quickly that even what seems to be a fairly wet patch contains only around 9 to 10 per cent of water and is apparently within the range of good operation.

Most ceramists believe that the screen distribution of the aggregate is one of the major criteria of a good ganister mix. Figures 16, 17, and 18 indicate that these theories are correct, and particularly that the optimum combination for the air-placement gun is surprisingly close to the theoretical standard recommended by most ceramic work. For example, most of the literature on the subject indicates that the ideal mix would be 45 per cent coarse material, 10 per cent middle size and 45 per cent fine material.

Figure 16 indicates that the percentage of coarse material is very important and that the optimum is approximately 50 per cent by weight. Anything from 42 to 60 per cent by weight would seem to be within commercial tolerance. The optimum of 50 per cent is a little higher than that theoretically recommended, and may reflect characteristics of the air-placement method.

This would indicate that the mechanical ramming action of the gun is such that density can be obtained with a higher percentage of coarse material than is considered theoretically possible. This should be advantageous because all laboratory and commercial work has indicated that the large particles are not attacked by slag.

Figure 17 indicates that in the air-placement operation the optimum percentage of middle material (minus 20, plus 70) is approximately 13 per cent. This is slightly higher than the theoretical quantity, and again indicates that the mechanical ramming ability of the gun will give density with coarser materials.

Theoretically, fine material in a ramming mix is undesirable since the finer the material the greater the slag attack. It should be remembered that the fine material is used only because maximum density is necessary. In a ramming mix, we really have two diametrically opposed conceptions. A minimum amount of fine material is desirable to reduce slag attack, but opposed to this is the fact that a maximum amount of fine materials gives maximum density and maximum depth of ceramic bond.

Air-Placement Has Advantages

The best lining is made by a compromise between these two extremes and, in the case of the air-placement gun, Fig. 18 would indicate that the optimum percentage is 37. This is somewhat lower than the theoretical 45 per cent, and again indicates that the gun has the mechanical ability to pack beyond the limits of theoretical standard sizes.

These tests offered conclusive evidence that air-placement is capable of providing a better patch than hand daubing for a number of reasons:

1. Air-placement provides a lower moisture content than is possible with hand patching.

2. For any given aggregate combination, air-place-

FIGURE 16
EFFECT OF COARSE MATERIAL

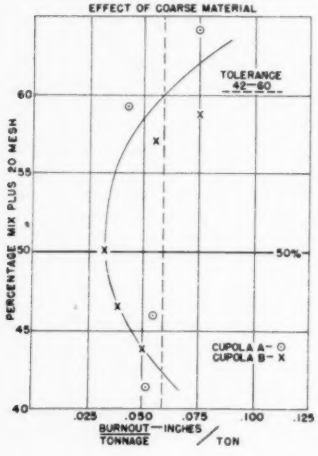


FIGURE 17
EFFECT OF MIDDLE MATERIAL

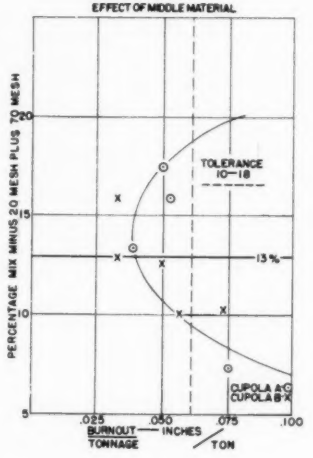
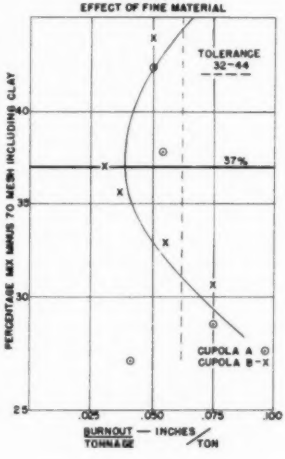


FIGURE 18
EFFECT OF FINE MATERIAL



ment permits lower clay contents in the patching mixture and thereby reduces slag penetration.

3. The monolithic nature of the patch gives more security against sloughing than does hand patching. The air-placement linings did not "peel away" from the cupola wall.

4. The exact shape of the cupola can be obtained more easily from day to day. This is true not only in the melting zone, but up to the charging door.

5. Since the cupola may be readily patched to standard shape each day, the lining near the shell is protected. Also, the easy control of dimension permits ready use of techniques such as contour patching.

6. Since patching shape is more readily obtained and burn-out per ton of metal is reduced, metallurgical control over the operation of the cupola is improved.

The work on ganister combinations and other variables confirmed the laboratory and pilot plant research. Conclusions based on all three test types are:

1. Maximum refractoriness and maximum plasticity of fire clay are important. The percentage of clay may range from 15 to 25 if it is of proper quality.

2. A combination of rounded Ohio ganister, which is essentially plus 20 mesh and minus $\frac{5}{16}$ in., with either fine crushed ganister or fine pure silica sand gives best results.

3. The coarse ganister should not be over 60 per cent of the mixture, preferably about 42-50 per cent.

4. Carbonaceous materials such as coke are not recommended in the melting zone.

5. Silica flour may improve lining quality, particularly when bentonite is used, but is not practical with air-placement equipment.

6. A small percentage of bentonite may be added to the mix to increase ceramic bond depth if needed.

7. Using the recommended round, coarse, ganister, fine silica sand (or finely crushed ganister), and high quality clay, the best proportion appears to be 2:2:1 by volume.

Handling Air-Placement Equipment

Although air-placement permits mechanical operation in patching, the best results were obtained after some practice. In other words, there is a certain amount of technique to be learned, as would be true for a molding machine, automobile or other mechanical equipment.

Many types of mixing were tried. It was finally determined that simple paddle mixing was adequate if the ganister and clay were reasonably dry. The technique worked out by Fulton Foundry and Machine Co., Inc., Cleveland, included a pug or paddle mixer discharging through a screen into a storage hopper. Since all ingredients are dry, storage is possible. Mixing can be done once a week or oftener, depending upon the capacity of the hopper.

Figure 19 shows the storage hopper and air-placement hopper. The air-placement hopper delivers a continuous flow of material to the cupola under pressure. The screened mixed ganister and clay is fed by gravity from the storage hopper.

The dry cupola patch mixture is conveyed by air pressure through the hose shown at the bottom of the lower pressure hopper in Fig. 19. The hose may be 50 to 100 ft long permitting of patching a number of cupolas without moving the pressure feed chambers.

Fig. 19—Screened mix of ganister and clay is fed from storage hopper to air-placement machine. The hose leads to the patching gun in the cupola under repair.

When the air-placement gun is in operation water is blended with the ganister and clay at the gun nozzle under control of the operator. One unusual feature is the ease of moisture control. When the mix is too dry, it is apparent because the rebound is excessive and the operation becomes dusty. When the mix is too wet, its wet appearance is instantly apparent, along with a softness and tendency to run slightly.

An unusual feature is that there is but little difference in actual moisture between a very wet patch and a very dry patch. Actual analysis showed that from the wettest to the driest patch the moisture content varied only from 7.1 to 8.7 per cent. Furthermore, if the patch becomes too wet through operator error, he merely "dries it up" by gunning dry material into the wet spot.

The gun is handled with an easy but constant motion to prevent the patch from piling up in one place. This technique provides maximum density of patch and gives best control over dimension. The equipment was found to be capable of handling more than 100 lb of ganister per minute of continuous operation, but in most cases 100 lb per minute was all an operator could control comfortably and accurately.

Acknowledgment

Operating tests of the air-placement process were made in the plant of the Fulton Foundry & Machine Co., Inc., Cleveland. The authors wish to express their appreciation for the cooperation of A. C. Denison, president; George Clifford, foundry superintendent; and Roy L. Denison, plant engineer.

"NO SMOKING"

ONE METHOD of avoiding atmospheric pollution is to remove from escaping industrial gases whatever solids or mists they contain. A wealth of equipment is available for this purpose, and several new variations have been introduced recently, according to an article in the Feb., 1949, issue of *Industrial Bulletin,* Arthur D. Little. Inc., Cambridge, Mass. Legislative action to control air pollution has been taken in several industrial cities, and recent Federal stream-pollution legislation sets a pattern which may eventually force more use of this equipment.

The engineer's unit for measuring airborne debris is the micron, which is a thousandth of a millimeter, or one twenty-five-thousandth of an inch. Face-powder particles are about ten microns across; permanent atmospheric dust, one micron or less, and particles of tobacco smoke average about 0.3 micron. Choice of filtration equipment depends on the size of the particles and on their concentration, which is measured in grains per cubic foot. An ounce equals 438 grains.

Centrifugal Precipitators

The speed and turbulence of the gas stream issuing from a factory determine whether or not it will carry out large-particle dusts and mists. Materials in the range of 50 to 100 microns and up, including the grit which coats office desks, coke breeze, sand, flour, and large liquid droplets, can be removed by centrifugal force in standard dry cyclones, the large conical objects commonly seen about factories. Adding a water spray increases the efficiency of these precipitators.

Somewhat finer dusts, such as those from combustion of powdered coal or from cement kilns, can be caught in specialized cyclones, or in dynamic precipitators, where whirling blades toss the particles into an area of still air. Filters of various fibers also remove relatively large particles from gases at moderate temperatures, and can handle a wide range of particle sizes with moderate effectiveness.

In one of the newer precipitation devices, low-velocity jets of water, or other liquid, are introduced perpendicular to the rapidly moving stream of dirty gas. The liquid breaks up into a fine spray from the brief, but violent, acceleration, giving unusually good contact between dust and water. The resulting mist, carrying the dust, is then centrifuged out in a cyclone. This unit apparently knocks out particles down to about 0.1 micron and somewhat smaller.

Fine Dust Removed Electrostatically

For capturing particles near or below one micron in size, such as permanent atmospheric dust, acid mists, or fine smokes, electrostatic precipitators are extremely effective. They also remove larger particles, including pollens up to 80 microns in diameter. The particles are charged electrically and then collected on an oppositely-charged plate.

For large-scale jobs, as in tar-mist knockout or pulp-mill chemical fume recovery, the collector plates are periodically shaken clean or are continually washed with a liquid. For light jobs, the plates may be treated with an adhesive and periodically washed, as in cleaning the air in textile plants, office buildings, or in plants for precision work, such as the manufacture of small ball bearings and instrument parts.

Ultrasonic precipitation, although still under development, has demonstrated high effectiveness with small particles from 15 microns to below 0.01 micron in diameter. High-frequency air vibrations set up by a special siren cause small particles of, say, carbon black, to collide and agglomerate to a size which can be caught by conventional cyclones. Such units are said to cost less than electrostatic equipment, with operating costs of the two being comparable. The technique is not as efficient, however, for dust concentrations below one grain per cubic foot. Industrial applications include collecting carbon black, acid mists, rock fines, and paper-pulp mill waste; ultrasonic precipitation is being considered for smokestacks.

A new method of capturing fine mists is in the experimental stage at M.I.T. A mist-bearing gas stream is sent up through a vertical shaft containing a powder which absorbs the mist. The stream bubbles through the powder as through a liquid, but does not carry it out of the shaft. Cleanup of sulfuric acid mists with 95 per cent efficiency has been reported for laboratory tests. The relatively large particles of the "fluidized" bed might perhaps also be used to collect finer solids.

SAFETY AND HYGIENE PUBLICATIONS

Published by American Foundrymen's Society

FUNDAMENTALS OF DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF EXHAUST SYSTEMS.

RECOMMENDED PRACTICES FOR METAL CLEANING SANITATION.

RECOMMENDED GOOD SAFETY PRACTICES FOR THE PROTECTION OF WORKERS IN FOUNDRIES.

GRINDING, POLISHING AND BUFFING EQUIPMENT SANITATION.

RECOMMENDED PRACTICES FOR INDUSTRIAL HOUSEKEEPING AND SANITATION IN THE FOUNDRY.

SYMPOSIUM ON FOUNDRY DUST CONTROL.

Low-cost fiber-type filters are using new materials and getting new jobs. Curled scrap vinyl plastic fibers are used to remove dust from the rooms where paint is sprayed, as glass fiber has been for some time. Curled casein fiber is used in a new replaceable automotive air filter. Filter paper is combined with a special medium-cost electronic treatment in a new ventilating-air cleaner.

There is not much need in industry for collecting particles under 0.1 micron, and conventional equipment can usually be adapted if the need arises. These very small particles are knocked onto filter surfaces by the movement of the gas molecules themselves, and they tend to stick, making collection fairly effective.

It is in the narrow range between 0.1 and 0.3 micron that capture is most difficult, and fine-grained filter papers, with consequent high pressure to push the gas through them, are required. There is a need for equipment to compete with electrostatic units and high-efficiency scrubbers for special applications in this range, such as exclusion of culture poisons from working areas in biological laboratories.

FILM TELLS STORY OF MALLEABLE INDUSTRY

AMERICA'S MALLEABLE IRON industry is dramatically portrayed in *"This Moving World,"* a 16 mm colored sound film produced by the Malleable Founders' Society and previewed in Cleveland September 22.

The Society produced the film in order to acquaint industrialists, students and the general public with the colorful malleable castings industry and the merits of its products.

Requiring 30 minutes running time, the film takes as its theme the importance of malleable iron castings in today's era of motion and speed, demonstrating the durability of parts made from malleable iron, their resistance to corrosion and shock and the ease with which they may be machined into finished parts. The film explains the part played by such castings in industries where machinery must be able to withstand sudden and repeated strains.

Production of *"This Moving World"* was supervised by a committee of Malleable Founders' Society members headed by Chairman Frank O. Parker, Dayton Malleable Iron Co., Dayton, Ohio. Other members of the committee were: C. S. Anderson, Belle City Malleable Iron Co., Racine, Wis.; George E. Bean, Eastern Malleable Iron Co., Wilmington, Del.; D. L. Boyes, Central Foundry Division, General Motors Corp., Saginaw, Mich.; Cal C. Chambers, Texas Foundries, Inc., Lufkin, Texas; R. J. LaMarche, American Malleable Castings Co., Marion, Ohio; and P. H. Vincent, Erie Malleable Iron Co., Erie, Pa. James H. Lansing, technical and research director of the Malleable Founders' Society, served as consultant to Roland Reed Productions, Beverly Hills, Calif., makers of the film. Edwin C. Hill is the film's narrator.

Society President James H. Smith, Central Foundry Division, General Motors Corp., Saginaw, Mich., has announced that the film is available throughout the country to interested technical society, school, industry and business groups. The film is being shown in a series of special parties being given in the nation's principal cities and will be shown in a display booth this month at the National Metals Congress in Cleveland. Inquiries from interested groups may be addressed to the Malleable Founders' Society, 1800 Union Commerce Bldg., Cleveland 14.

Below: A few of the scenes from the Malleable Founders' Society film, "This Moving World."

Offers Cash Prizes For Technical Papers On Stainless Steel Usage

CASH AND PRIZE AWARDS totalling more than $5,000 are being offered by the Cooper Alloy Foundry Co., Hillside, N. J., for the purposes of stimulating interest in existing applications of stainless steel to various industries, and encouragement of further advances in the battle against corrosion. The contest is divided into separate sub-contests, each covering a major field of stainless steel application—chemical, food, textile, paper and pulp, aircraft, marine, petroleum, etc.

The chemical field has been selected for the first contest. Papers dealing with "Applications for Cast Stainless Steel in the Chemical Industry" will be accepted between October 1, 1949, and May 1, 1950. Prizes, conditions and specific rules for other contest will be announced at a later date.

A panel of judges will examine all entries, making the awards on the basis of thoroughness of research and clarity of presentation. Prizes for papers in the chemical industry contest are: 1st prize—$250.00, 2nd prize—$150.00,—3rd prize—$100.00. An additional 100 prizes, consisting of cast stainless steel paper weights will be awarded.

Complete contest information may be obtained by writing Contest Editor, Cooper Alloy Foundry Co., Hillside, N. J.

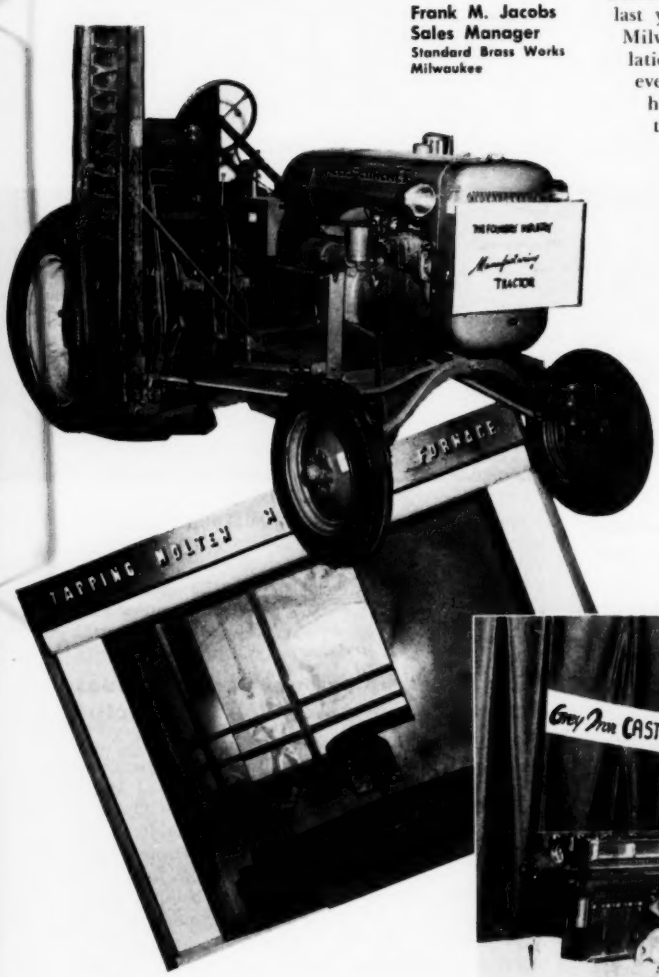
Maryland Employment Division Issues Coremaker - Molder Job Prospectus

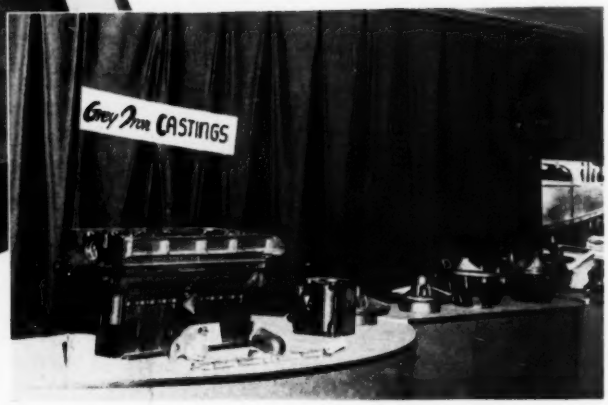
AN EXCELLENT EXAMPLE of a means by which "new blood" may be attracted to the foundry industry is a job prospectus recently issued by the State of Maryland's Employment Service Division, "Job Outlook in the Baltimore Area—Coremaker and Molder." Designed for distribution to unemployed persons applying at the local employment offices, the two-page sheet explains the nature of coremaking and molding work, employment prospects in the area, entry jobs and lines of promotion, prevailing wages and hours, job requirements, and advantages and disadvantages of employment as a coremaker or molder in Maryland foundries.

A. F. S. CHAPTER EXHIBITS AT WISCONSIN FAIR

Frank M. Jacobs
Sales Manager
Standard Brass Works
Milwaukee

Continuing its program of educating the public to the part played by castings in today's economy, the A.F.S. Wisconsin Chapter again this year exhibited at the Wisconsin State Fair, Milwaukee, August 20-28. Situated in the Fair's "Wisconsin at Work" building, the exhibit featured such major castings—using Wisconsin industrial products—as automobile engines, farm equipment and machinery, as well as displays of Wisconsin-made castings used in everyday life. This year's exhibit was not as elaborate as the working foundry exhibit sponsored by the Chapter at last year's Wisconsin State Centennial Exposition, Milwaukee—one of the most outstanding public relations efforts on behalf of the foundry industry ever achieved by an A.F.S. Chapter. The 1949 exhibit, nevertheless served as a strong reminder to the public that the foundry industry is the backbone of the American way of life. Headed by George E. Tisdale, Zenith Foundry Co., and Russell J. Anderson, Belle City Malleable Iron Works, Racine, the Chapter's committee for coordinating and organizing the exhibit consisted of C. A. and J. B. Gutenkunst of the Milwaukee Malleable & Grey Iron Works; H. Holtz, Sivyer Steel Casting Co., Milwaukee; A. Blumberg, Wehr Steel Co., Milwaukee; C. L. Liebau, Federal Malleable Co., Milwaukee; Harry E. Ladwig, Allis-Chalmers Mfg. Co., Milwaukee; R. M. Jacobs, Standard Brass Works; Milwaukee; and E. L. Roth of the Motor Castings Co., Milwaukee.





(Photos courtesy W. V. Napp, Badger Fire Brick & Supply Co., Milwaukee)

WHO'S WHO

Walter Bonsack

Walter Bonsack, whose article appearing on Page 39 of this issue, *"Trends in Aluminum Casting Alloys,"* is this year's A.F.S. Exchange Paper to France's Association Technique de Fonderie, is a native of Berlin, Germany . . . A graduate of the Technical College of Berlin, where he received a degree in Metallurgical Engineering, and where he was an instructor in that subject from 1924 to 1927. Mr. Bonsack came to this country in 1927 as director of laboratories for the National Smelting Co. (now the Apex Smelting Co.), Cleveland, his present position . . . A past chairman of the A.F.S. Aluminum & Magnesium Division, he is the author of several articles on light metals casting and is a frequent speaker on that subject before technical society groups.

N. J. Dunbeck

Norman J. Dunbeck, co-author with T. E. Barlow of *"Patching the Cupola — Develop Air-Placement Process,"* Page 48, is a National Director of the American Foundrymen's Society . . . Member of a "foundry family," Mr. Dunbeck joined the training course offered by the Donner Steel Co., Buffalo, after graduating with a B.S. in Chemical Engineering from the Catholic University of America, Washington, D. C., in 1924. In 1925, he became foundry engineer for the Symington Co., Rochester, N. Y. . . . The following year Mr. Dunbeck joined his present employer, Eastern Clay Products, Inc., Jackson, Ohio, where he established the company's first laboratory . . . He was appointed eastern plant manager for the company in 1927, sales engineer in 1928, production manager in 1931, and is today vice-president of the company . . . Active for several years in A.F.S. Sand Division committees, Mr. Dunbeck has presented papers at several A.F.S. National Conventions and has spoken before almost all A.F.S. Chapters in the United States and Canada.

T. E. Barlow

Thomas E. Barlow, co-author of *"Patching the Cupola — Develop Air-Placement Process,"* Page 48, with N. J. Dunbeck, has a wide background in foundry research, metallurgical technology and sales . . . A native of Detroit, Mr. Barlow attended the University of Michigan, graduating with a B.S. degree in Metallurgy in 1934 . . . After two years as chief metallurgist with Ecorse Foundry Co., Detroit, Mr. Barlow became a research engineer at Battelle Memorial Institute in 1936 . . . Leaving Battelle in 1939, he was appointed technical director for the Copper, Iron & Steel Development Association, Cleveland . . . In 1940, Mr. Barlow joined the Vanadium Corp. of America, Detroit, as foundry engineer, leaving there in 1944 to return to Battelle as a research engineer . . . In 1947, he was appointed sales manager for Eastern Clay Products, Inc., his present position . . . Long active in A.F.S. Committee work, Mr. Barlow is a past chairman of the A.F.S. Central Ohio Chapter, and has been a frequent speaker at Chapter meetings.

A. W. Gregg

Alfred W. Gregg's article appearing on Page 27 is the 1949 A.F.S. Exchange Paper to the International Foundry Congress, Amsterdam, Holland—*"Ferrous Melting Furnaces in the United States and Canada."* An A.F.S. John H. Whiting Gold Medalist (1944), Mr. Gregg is chairman of the A.F.S. Educational Division and vice-chairman of the A.F.S. Chicago Chapter . . . Holder of B.S. (1903) and M.S. (1904) degrees from Purdue University, he began his foundry career as metallurgist for the Latrobe Steel Co., Melrose Park, Ill., in 1904 . . . He was for 15 years foundry superintendent for the Bucyrus-Erie Co., South Milwaukee, Wis., and for seven years superintendent of the Bonney-Floyd Co. plant at Columbus, Ohio . . . Mr. Gregg joined his present employer, the Whiting Corp., Harvey, Ill., as executive engineer in the company's Foundry Equipment department . . . A prolific author, Mr. Gregg has written many articles for the technical press on foundry practice and foundry education, and is well-known to all A.F.S. Chapters as a speaker on these subjects.

G. Hobman

G. Hobman, author of *"How to Measure Surface Roughness of Castings,"* Page 46, is a native of England and for 10 years has been service manager with International Meehanite Metal, Ltd., in charge of servicing Meehanite foundries in Southern Europe . . . A graduate in Metallurgical Engineering from Sheffield University, Mr. Hobman was formerly chief chemist and metallurgist with the London and Northeastern Railway Co., and was for a short period with the Royal Aeronautical Establishment at Farnborough, England, prior to joining International Meehanite 10 years ago.

Southwest Research Institute Inaugurates Research Service

MECHANICAL ENGINEERING research facilities of the Southwest Research Institute of Houston and San Antonio, Texas, are now available on a cost basis to individuals, corporations, technical and trade associations. Research is performed by the non-profit Institute on a basis whereby the sponsor outlines his problems and provides funds for carrying out the work.

The Mechanical Engineering Department is composed of Analysis, Design, Mechanical Laboratory and Engine Laboratory sections, handling each problem through these successive stages of development. Highly qualified staffs of technicians are assigned to each problem and have the most modern facilities at hand to aid in its solution. All patent rights accruing from the work of the Institute become the property of the sponsor. Questions concerning specific problems and Institute facilities may be addressed to Dr. Emory N. Kemler, Director, Department of Mechanical Engineering, Southwest Research Institute, Oil and Gas Bldg., Houston, Texas.

CHAPTER ACTIVITIES NEWS

Philadelphia

J. L. Furey
Chapter Reporter

THE ANNUAL OUTING of the Philadelphia Chapter, held June 11 at the Langhorne Country Club, Philadelphia, was enjoyed to the fullest extent by members and guests. Chairman W. J. Gallana, Rogers Brown Lavino Co., Philadelphia, and his entertainment committee worked like Trojans to make the day's Outing a success. Activities consisted of golf, quoits, and a baseball game between Management and Suppliers, won by the Suppliers. There were so many game and door prizes that almost everyone attending left with a souvenir of the day.

Chairman W. B. Morley, Link-Belt Co., Philadelphia, and Vice-Chairman Clyde B. Jenni, General Steel Castings Corp., Philadelphia, relaxing at the Philadelphia Chapter's Annual Outing, held June 11.

Wisconsin

Frank M. Jacobs
Standard Brass Works
Chapter Reporter

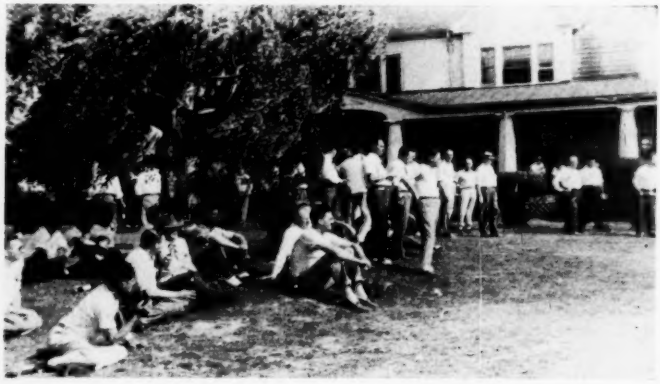
THE FIRST MEETING of the season, held September 9 at the Hotel Schroeder, Milwaukee, was attended by 190 foundrymen and guests. The technical session was devoted to separate sectional meetings.

Theodore Redin, William Demler & Bros. Co., spoke to the Steel Group on *"Coreblowing in the Steel Foundry."* Victor Ziemer, Maynard Electric Steel Casting Co., was chairman of the meeting.

"Behavior of Sands at Elevated Temperatures" was the subject of Joseph Gitzen of the Delta Oil Co., who was called upon at the last minute as substitute speaker for the Gray Iron and Technical Group. The scheduled speaker was Frank S. Brewster, Harry W. Dietert Co., whose plane was grounded in Detroit. G. P. Antonio, Walter Gerlinger, Inc., and A. Janes, Jr., Standard Foundry Co., were chairman and co-chairman, respectively, of the meeting.

Frank Harris of the Belle City Malleable Iron Co., Racine, spoke to the Malleable Iron & Pattern Group on *"Pattern Gating for Malleable Casting."* Harry Arneson of the Spring City Pattern Works, and H. C. Stone, Belle City Malleable Iron Co., presided.

"Sand and Sand Binders for Non-Ferrous Foundry" was the subject of an address made by Earl Woodliff, Foundry Sand Service Engineering Co., to the Non-Ferrous Group. Duane Bosma of the Bucyrus-Erie Co. was group chairman.



Foundrymen watching a baseball game between Management and Suppliers, Philadelphia Chapter's Annual Outing, Langhorne Country Club, June 11.

Mo-Kan

Thomas F. Shadwick
Witte Engine Works
Chapter Reporter

AFTER A TWO MONTH'S vacation, the first meeting of the 1949-50 season was held September 7 in the Pine Room of Wachner's Restaurant, Kansas City, Mo. Members and their guests filled the banquet room, which was also used for the business meeting and technical session following dinner.

Chapter Chairman J. T. Westwood, Blue Valley Foundry Co., Kansas City, Mo., conducted the business meeting and introduced the following guests: L. G. Masner, Joseph Dixon Crucible Co.; Thomas H. Painter, Morgan Foundry Co.; T. F. Fallon, General Refractories Co.; J. Vattoria, American Brake Shoe Co.; Donald Braun, Atchison Specialties Co.; L. E. Clain, Union Pacific Railroad; Mark Whitfill, Witte Engine Works; Jack Clifford, Clifford Foundry; Harold Leopold, Bendix Aviation Corp.; and B. T. Glover, M. A. Bell Foundry Supply Co.

The guest of honor and speaker of the evening, R. L. McIlvaine,

National Engineering Co., Chicago, was introduced by Vice-Chairman Clarence W. Culbertson, M. W. Warren Coke Co. Mr. McIlvaine spoke on *"Foundry Modernization and Mechanization in the Smaller Shop,"* showing slides of actual installations of mechanical sand handling, molding, conveying, pouring, shakeout and castings cleaning equipment.

Mr. McIlvaine said that the foundrymen who decides to mechanize must decide the type of mechanization, where to begin, how far to go with mechanization, how to cut costs, save labor, increase production and maintain quality control by means of mechanization.

Mr. McIlvaine added that proper mechanization requires thorough study of needs, and careful planning and execution. Mr. McIlvaine's talk served as an inspiration to members to better their products, methods and working conditions in the foundry.

Texas

E. P. Clarke
American Wheelabrator & Equip. Corp.
Chapter Reporter

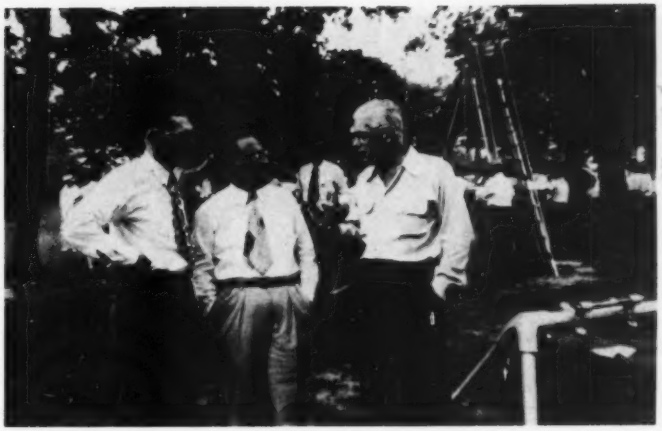
THE FIRST MEETING of the season was held September 16 in the Plaza Hotel, San Antonio, with 65 members and their guests in attendance. Following dinner, the Naval Research Laboratory films, *"Gating Systems for Metal Castings," "Finger Gating,"* and *"Step Gating,"* were shown at the meeting.

Upon completion of each film, questions or comments were addressed to a three-man panel, representing steel, gray iron and non-ferrous foundries. These discussions were lively, with excellent audience participation. It was generally agreed by the audience that the Naval Research Laboratory had done an excellent job of exploring the phenomena and behavior of flowing metal.

British Columbia

H. M. Brownrigg
British Columbia Research Council
Chapter Secretary

REVIEWING SUMMER ACTIVITIES of the Chapter—the boundaries of the British Columbia Chapter have been extended to include the provinces of Alberta and Saskatchewan; new officers have been installed; and arrangements have



Guests Robert P. Schauss (left), National Malleable & Steel Castings Co., Cleveland, and A.F.S. Past National President W. B. Wallis (center), Pittsburgh Lectromelt Furnace Corp., talking over foundry problems with Adolph Scheid, Columbia Tool Steel Co., Chicago Heights, Ill., at the Chicago Chapter's Outing, held August 12 at Lincolnshire Country Club.

Foundrymen of the Central Ohio Chapter teeing off for the golf tourney at the Chapter's Annual Picnic, August 12, at Brookside C.C., Columbus.

This happy group of foundrymen and guests were snapped as they arrived for Central Michigan Chapter's recent annual outing at Coldwater, Mich.

Photographed on the porch of the Alliance Country Club, Alliance, Ohio, during the Canton District Chapter's Annual Picnic, September 20, were, front row, left to right: Philip Huff, Tony Waller, George Suppan and F. A. Dun, all of the Babcock & Wilcox Co. Back row, left to right: Alfred S. Morgan of Babcock & Wilcox; W. C. Beatty, J. Weber, Paul Muntz, Robert Bair and L. A. Weaver, all of United Engineering & Foundry Co.

been made for a number of interesting speakers for this year.

Chapter boundaries were extended because Alberta and Saskatchewan are more closely allied geographically with British Columbia than with the Ontario Chapter. Although it is difficult for foundrymen from these provinces to attend Vancouver meetings, they are nevertheless cordially invited to attend or to just drop in for a chat. Notices of British Columbia activities will be mailed to any interested persons in these provinces by requesting them from Chapter Secretary-Treasurer W. R. Holeton, British Columbia Research Council, Hut 01, University of British Columbia, Vancouver, B. C.

Northeastern Ohio

R. W. Herrmann
Penton Publishing Co.
Chapter Reporter

The 1949-50 season opened with a clambake dinner September 8 at the Tudor Arms Hotel, Cleveland. Two color motion pictures, *"Finger Gating"* and *"Step Gating,"* were shown. The films were prepared by William H. Johnson and William O. Baker of the Naval Research Laboratory, Washington, D. C. Mr. Johnson was present to lead discussion of the films.

The films are a continuation of an earlier work, *"Gating Systems for Metal Castings,"* which was shown before the chapter last year, and depict the flow of molten steel at 3000 F in step gating and finger gating systems. The purpose of the study, according to Mr. Johnson, is to attempt to develop better methods of finger and step gating.

Studies in the film, *"Finger Gating,"* were conducted with finger gating systems having a total finger area twice that of the sprue area. The investigation showed that uniform flow could be secured in finger gates when the total finger area was greater than the sprue area. This was done by using gates that split the fluid stream into equal parts, or that absorbed the momentum of the stream. This absorption of momentum was obtained by bending the runner away from the casting, by using a tapered runner, by designing the runner so as to have the molten metal impinge upon itself, and by using pools on both sides of the sprue as enlargements of the runner.

In the film *"Step Gating,"* studies included the uses of tapered sprues, steps curved downward from the sprue, steps with a common junction and reversed sprues. Three-step gating systems were used.

Of the step gating systems examined, two were effective in producing the desired sequence of feeding through the steps. One of these systems employed upturned steps with the bottom step steeply inclined, and the two upper steps radiating from a common junction. The second system utilized the reversed sprue. It consisted of a pool at the bottom of the downgate and

Golfers at the A.F.S. Ontario Chapter's Annual Picnic, held August 27 at the estate of Rolph Barnes, Waterdown, Ont., were left to right: Past Chairman James Dalby, Wilson Brass & Aluminum Foundry, Toronto; Chapter Chairman Jack H. King, Werner G. Smith Co., Ltd., Toronto; Past Chairman Russell A. Woods, Geo. F. Pettinos, Ltd., Hamilton; and Vice-Chairman Murray Tallman, A. H. Tallman Bronze Co., Ltd., Hamilton. (Photograph courtesy Reginald Williams, Canadian Westinghouse Co., Ltd.)

Chapter President Robert C. Woodward of the Bucyrus-Erie Co., Milwaukee, welcomes foundrymen to the first meeting of the 1949-50 season of the Wisconsin Chapter, held at the Hotel Schroeder, Milwaukee, September 9.

a taper in the reversed sprue portion of the system. This gate produced more nearly true sequence flow than any other tried. In addition, it allowed the metal to enter the mold quietly.

During the discussion period, Mr. Johnson pointed out that the method of experimentation used shows only which gates feed and does not show the effect of feeding upon the casting. When asked about the effect of straining cores on metal flow in various systems, he stated that he had not made sufficient tests using them to give a fair indication of results.

He also was asked what effect the basin and plug method of pouring used in the tests had on the step gating systems studied. In answering, he said that slow pouring will make almost any step gate work properly. Consequently, the basin and plug pouring method was used to obtain a rather fast and steady state of pour so that only properly designed gating systems would work satisfactorily.

Twin City
O. J. Myers
Werner G. Smith Co.
Chapter Reporter

NEARLY 100 members and guests inaugurated the 1949-50 season by attending an excellent meeting at the Covered Wagon, Minneapolis on September 13.

The main speaker of the evening, Vaughan C. Reid, City Pattern Foundry and Machine Co., Detroit, spoke on *"Materials used in the Construction of Production Pattern Equipment."* He was introduced by the new chairman of the Chapter, Frank Austin, Crown Iron Works and by Joseph Costello, American Hoist & Derrick Co.

According to Mr. Reid, patterns are given too little consideration in production control. Improper design of pattern wastes both time and materials in the foundry. The use of driers and jigs, as well as of properly designed patterns, does much to save money by inhibiting this waste.

The speaker said that pattern material costs much less than the labor involved in making the patterns. These pattern materials should be of such a nature that their surfaces resist abrasion – a function of hardness and toughness of the metal. The chemical composition and the microstructure of the metal also controls the wear of a metal pattern. Under production conditions, the wear is a function of the pressure and speed of impact of the sand (kinetic energy), and the temperature of the sand during molding, the speaker said.

Mr. Reid's firm has been successful in substituting a 4 per cent copper, 3 per cent silicon (93 per cent Al) alloy (Alcoa 108) for the 8 per cent copper, 2 per cent silicon (80 per cent Al) old Number 12 alloy as a pattern metal. This newer alloy, when solution heat-treated showed a Rockwell E hardness between 92 and 97 with a tensile strength of 41,000 psi.

The speaker recommended two bronze alloys for making bronze

(Continued on Page 79)

Prominent Tennesseans were guests of the Tennessee Chapter's Annual Barbecue Supper, held at the Signal Mountain Country Club, August 27. Left to right: Rep. J. B. Frazier of Tennessee's Third District; George McInturff, Chattanooga City Commissioner; Chapter Chairman Karl Landgrebe, The Wheland Co., Chattanooga; P. R. Oligiati, Chattanooga Streets and Sewers Commissioner; Roy Hyatt, Chattanooga Commissioner of Fire and Police; and Chapter Vice-Chairman Paul Arnold of U. S. Pipe & Foundry Co.

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Vulcan Foundry Co.
Oakland, Calif.
Director
Northern California Chapter

Lyle Fulton
Geo. D. Roper Corp.
Rockford, Ill.
Director
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C. B. Schneible
Claude B. Schneible Co.
Detroit
Director
Detroit Chapter

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American Brake Shoe Co.
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Rochester Chapter

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G. E. Tisdale
Zenith Foundry Co.
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Wisconsin Chapter

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Montreal, Que.
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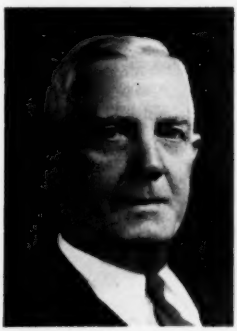
Eastern Canada Chapter

Fred J. Pfarr
Lake City Malleable Co.
Cleveland
Vice-President
Northeastern Ohio Chapter

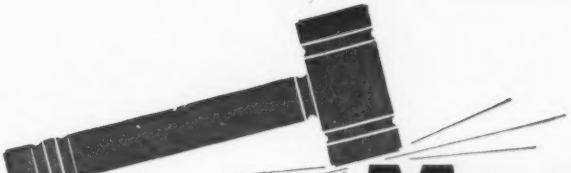


Wm. Oberhelman
Oberhelman Ritter Foundry Co.
Cincinnati
Director
Cincinnati Chapter

Ray Fickenworth
Indianapolis
Treasurer
Central Indiana Chapter

C. O. Penney
C. S. Card Iron Works Co.
Denver
Chairman
Timberline Chapter

J. T. Westwood, Jr.
Blue Valley Foundry Co.
Kansas City, Mo.
Chairman
Mo-Kan Chapter



Chapter Meetings

Early Programs Presage Instructive Year

CHAPTER MEETING PROGRAMS announced to date indicate that A.F.S. members will hear outstanding, informative speakers during the 1949-50 season. Reflecting emphasis placed on program building at Chapter Officers Conferences of the past few years, this season's meetings—many already laid out for the entire year—are indicative of interest and thoughtfulness on the part of Chapter Program Committees. Committees are aided in their planning by the A.F.S. CHAPTER SPEAKERS LIST, the Speaker Evaluation Reports sent by Chapter members to A.F.S. Headquarters after each meeting, and by the A.F.S. FILM DIRECTORY.

OCTOBER 17

QUAD CITY
Ft. Armstrong Hotel, Rock Island, Ill.
BRADLEY H. BOOTH
Carpenter Bros., Inc.
"Production and Uses of Foundry Sands"

OREGON
New Heathman Hotel, Portland
S. C. MASSARI
A.F.S. Technical Director
Film: *"Fluid Flow in Transparent Molds"*

OCTOBER 21

BIRMINGHAM DISTRICT
Tutwiler Hotel, Birmingham, Ala.
WALTER JAESCHKE
Whiting Corp.
"Mechanization of the Cupola"

TEXAS
Texas State Hotel, Houston
ROUND TABLE DISCUSSIONS

WASHINGTON
Gowman Hotel, Seattle
S. C. MASSARI
A.F.S. Technical Director
Film: *"Fluid Flow in Transparent Molds"*

OCTOBER 21-22

CHESAPEAKE
METROPOLITAN
PHILADELPHIA
Stevens Institute of Technology, Hoboken, N. J.
REGIONAL FOUNDRY CONFERENCE

OCTOBER 28

CHESAPEAKE
Engineers' Club, Baltimore
ROUND TABLE DISCUSSIONS

TRI-STATE
Mayo Hotel, Tulsa, Okla.
CLYDE A. SANDERS
American Colloid Co.
"How Did Old Timers' Practices Compare With Modern Sand Practices"?

OCTOBER 28-29

CENTRAL MICHIGAN
SAGINAW VALLEY
WESTERN MICHIGAN
DETROIT
MICHIANA
Michigan State College, East Lansing
REGIONAL FOUNDRY CONFERENCE

NOVEMBER 2

MO-KAN
Fairfax Airport Cafe, Kansas City, Mo.
CLYDE A. SANDERS
American Colloid Co.
"Modern Trends in Foundry Practice"

TOLEDO
Toledo Yacht Club, Toledo
Speaker to be announced
Film: *"Fluid Flow in Transparent Molds"*

NOVEMBER 3-4

CENTRAL INDIANA
MICHIANA
Purdue University, Lafayette, Ind.
REGIONAL FOUNDRY CONFERENCE

NOVEMBER 4

WESTERN NEW YORK
Hotel Sheraton, Buffalo
JOSEPH H. SANDER
Tonawanda Electric Steel Castings Co.
Films: *"Use of Chaplets"* and *"Use of Chills"*

NOVEMBER 7

METROPOLITAN
Essex House, Newark, N. J.
PANEL MEETINGS

CENTRAL ILLINOIS
Jefferson Hotel, Peoria
LESTER B. KNIGHT
Lester B. Knight & Associates, Inc.
"Foundry Mechanization"

NOVEMBER 8

N. ILLINOIS-S. WISCONSIN
Beloit, Wis.
WM. BALL, JR.
R. Lavin & Sons, Inc.
"Effective Essentials Required in Making a Casting"

NOVEMBER 8 (continued)

ROCHESTER
Seneca Hotel, Rochester
JAMES H. SMITH
General Motors Corp.
"Future of the Foundry Industry"

NOVEMBER 10

NORTHEASTERN OHIO
Tudor Arms Hotel, Cleveland
R. G. MCELWEE
Vanadium Corp. of America
"Application of Research to the Foundry Industry"

ST. LOUIS DISTRICT
St. Louis, Mo.
CLYDE A. SANDERS
American Colloid Co.
"The Side Floor Molder Vs. the Machine"

NOVEMBER 11

PHILADELPHIA
Engineers' Club, Philadelphia
ZIGMUND MADAGEY
Caterpillar Tractor Co.
"Does Core Blowing Belong in Your Shop?"

EASTERN CANADA
Mount Royal Hotel, Montreal
C. V. NASS
Beardsley & Piper Co.
Film: *"Better Methods for Making Molds and Cores"*

WISCONSIN
Schroeder Hotel, Milwaukee
EDWARD A. MCFAUL
Midwest Institute, Chicago

NOVEMBER 14

CINCINNATI DISTRICT
Engineering Society, Cincinnati
T. E. BARLOW
Eastern Clay Products, Inc.
"Application of Refractory Linings by the Bondact Process"

CENTRAL OHIO
Shawnee Hotel, Springfield, Ohio
CHARLES H. BARNETT
Foundry Equipment Co.
"Modern Foundry Core and Mold Ovens"

NOVEMBER 17

TWIN CITY
Covered Wagon, Minneapolis
J. C. NEEMES, JR.
International Nickel Co.
"Ductile Cast Iron"
JOINT MEETING WITH ASTM CHAPTER

FOUNDRY Personalities

John C. Pangborn, first vice-president and general manager of the Pangborn Corp., Hagerstown, Md., a visitor to Eire, was recently a guest of the Ironfounders' Association of Eire at its meeting on August 30.

Sanford H. Bennett succeeds **Joseph N. Moorhead** as manager of the Buffalo plant of the American Magnesium Corporation. Mr. Bennett began his career with the

S. H. Bennett

Cleveland permanent mold plant of the Aluminum Co. of America in 1929, serving in several Alcoa plants in various capacities. Immediately prior to his appointment as manager of the Buffalo plant of the American Magnesium Corp., Mr. Bennett was chief engineer of Alcoa's Cleveland plant. He is a graduate of Fenn College, Cleveland.

James R. Hewitt, Jr., 1213 Capitol Ave., Houston, Texas, has been appointed Texas and Louisiana representative for the Foundry Equipment Company's line of Coleman core and mold ovens.

J. Earl Harrington, Army Ordnance Department development engineer, has been appointed executive secretary for the Western Society of Engineers. A graduate of the Illinois Institute of Technology, Mr. Harrington was for 12 years with the City of Chicago Bureau of Engineering. During the war he served as consultant and coordinator of engineering for the Army's Quartermaster General, and later as Chief engineer with the Explosives Branch of the U. S. Army Ordnance Department.

William C. Howard, Jr., and **Walter E. Foreman** have been appointed field engineers for the Norton Co., Worcester, Mass. Mr. Howard will make his headquarters with the company's offices in Hartford, Conn., and Mr. Foreman with the Cleveland offices.

George W. Cannon was retired as chairman of the board of Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., as of August 31 pursuant to a retirement policy of the company. He has been vice-president and president, as well as board chairman, of the company which he

G. W. Cannon

founded 41 years ago with Donald J. Campbell and Ira A. Wyant. From a small beginning in 1908 the three men, starting with $3000, built an organization reported to be the world's largest independent foundry.

On September 29, Mr. Cannon left for a tour of Switzerland, France, Germany, England, and Sweden where he will spend approximately six weeks studying foundry methods, engineering, and metallurgy. A Past Director of the American Foundrymen's Society, he constantly strove to develop the highest skills of foundry practice and took the lead in the recent rehabilitation of Muskegon's Hackley Manual Training School foundry (AMERICAN FOUNDRYMAN, September, 1949, page 20, and March, 1949, page 29).

Franklin P. Goettman, the Duriron Co., Dayton, Ohio, an active member of several A.F.S. Sand Division Committees, was recently named chairman of the Sand Division's Green Sand Properties Committee. Mr. Goettman succeeds **Bradley H. Booth,** Carpenter Bros., Inc., Milwaukee, who requested that he be relieved of the chairmanship because of other work. Mr. Goettman is an active member of the Sand Division's Core Washes and Pastes Subcommittee, Flowability Committee and Grading & Fineness Committee, in addition to his long-time membership on the Green Sand properties Committee.

George Hobson of Malden, Mass., has been named executive representative for the Claude B. Schneible Co., in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island. He will maintain offices at 197 Clifton St., Malden, Mass.

Thornton C. Bunch, master molder in charge of the Navy's Pearl Harbor, Hawaii, foundry and pattern shops for the last nine years, has been transferred to

T. C. Bunch

the Navy's Mare Island Naval Shipyard. Mr. Bunch replaces Master Molder **Joseph Bentley,** who retired last August 1 after 28 years of service with the Navy. Mr. Bunch, a graduate of the New Mexico School of Mines, became an apprentice molder at the Norfolk Naval Shipyard in 1927, was assigned to Pearl Harbor in 1935, appointed master molder in 1940.

John Mitchell, a recent graduate of the Missouri School of Mines and an active member of the A.F.S. Student Chapter there, has accepted a position in the Metallurgical Department of the Key Co., East St. Louis, Ill.

John T. Ramsden, chief engineer of the Tabor Mfg. Co., Philadelphia, recently retired from active duty at the age of 87, having completed 48 years' service with Tabor. Mr. Ramsden joined Tabor in 1901, and has since designed many of the company's foundry machines, including the original Tabor hand ram, hand rollover, hand draw machine, and its offshoot —the jar ram, power rollover, power draw machine. He also played an active part in designing jarring valves, the air-on-oil pattern draw, and the elastic hand flask clamp. Since his recent retirement, Mr. Ramsden has been residing at Stony Hill Road, Bethel, Conn., c/o E. D. Wells.

Joseph H. Parsons and **Robert B. Pogue** have been appointed vice-presidents and **Rosser L. Wilson** chief engineer of the Brake Shoe and Castings Division of the American Brake Shoe Co. Mr. Parsons, formerly assistant vice-president, will be

J. H. Parsons

R. L. Wilson

R. B. Pogue

in charge of miscellaneous casting sales. Mr. Pogue, formerly chief engineer, continues in charge of engineering. Mr. Wilson was formerly assistant chief engineer.

J. A. Darr, recently resigned as technical advisor to the general manager of the Albion Malleable Iron Co., Albion, Mich., has joined the staff of the Erie Malleable Iron Co., Erie, Pa.

(Continued on Page 85)

A. F. S. CHAPTER DIRECTORY

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WESTERN MICHIGAN CHAPTER *Secretary*, Ross Shaffer, Lake Foundry & Machine Co., First & Water Sts., Muskegon, Mich.

WESTERN NEW YORK CHAPTER *Secretary*, R. E. Walsh, Hickman, Williams & Co., 32 Eastwood Place, Buffalo, N. Y.

WISCONSIN CHAPTER *Secretary*, G. E. Tisdale, Zenith Foundry Co., 1501 So. 83rd St., West Allis, Wis.

STUDENT CHAPTERS

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UNIVERSITY OF ILLINOIS *Secretary*, Eugene Keith Van Ness

UNIVERSITY OF MINNESOTA

MISSOURI SCHOOL OF MINES *Secretary*, Martin L. Slawsky

OHIO STATE UNIVERSITY *Secretary-Treasurer*, Arthur Stoner

OREGON STATE COLLEGE *Secretary*, Leonard M. Preston

TEXAS A & M COLLEGE *Secretary*, Victor C. Henkel

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FOUNDRY Literature

Readers interested in obtaining additional information on items described in Foundry Literature should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the items by means of the convenient code numbers.

Graphite Products

OT101—The United States Graphite Co. announces the availability of nine bulletins listing the properties, applications and advantages of Mexican Graphite and Mexican Graphite products. Described in the bulletins are No. 348 Mexican Graphite (Bulletin G-3); No. 34-40 Mexican Graphite (G-4); Mexican Graphite Mold Coatings (G-5); Mexaloy, for ladles, spouts, runners and cupola linings (G-8); No. 866 Hot Topping Compound (G-9); Mexacote—an all-purpose blacking (G-10); No. 8 Mexican Graphite (G-11); Mexican Graphite Cordip (G-12); and Pulverized Mexican Graphite Products (G-13). When requesting information on these products, please specify which bulletins desired.

Laboratory House Journal

OT102—*Precisionomics*, a new external house journal recently launched by the Precision Scientific Co., is issued bimonthly and is devoted to items of general interest to all scientific and laboratory workers, as well as to articles concerned with specific industries such as the foundry and allied metals industries. Readers of American Foundryman whose work involves laboratory research will be placed upon the mailing list of *Precisionomics* upon request.

Centrifugal Casting

OT103—The Cooper Alloy Foundry Co. announces the publication of two new bulletins dealing with the development of techniques for the casting of high alloy steel centrifugally in permanent metal molds. The methods evolved for mass production were originally developed to meet jet engine ring requirements, but have since been put to use in the production of other cylindrical components. The two publications—"Casting Centrifugally in Permanent Metal Molds," reprinted from the May, 1949, issue of AMERICAN FOUNDRYMAN, and "Casting Stainless Steel Centrifugally," reprinted from the January 27 issue of *Iron Age*—are designed to complement each other. One is highly technical in nature, while the other is pictorial. As a set, they represent a complete discussion of the subject. Copies are available free-of-charge.

Abrasion Resistant Alloy

OT104—A six-page bulletin, "How to Reduce Abrasive Wear with Thermalloy HC-250," will be mailed upon request by the Electro-Alloys Division of the American Brake Shoe Co. This bulletin describes the physical properties of abrasive-resistant Thermalloy HC-250, and lists its uses and advantages. Physical properties are compared with those of 13 per cent manganese steel, ABK metal, and white cast iron, in a carefully compiled table. The bulletin also describes case histories of the metal, giving actual field service data in each case, and information on machining and high-temperature service.

Blast Cleaning Machines

OT105—Two batch-type blast cleaning machines are described in bulletins recently issued by the American Wheelabrator & Equipment Corp. Bulletin 114-A describes the new 36 x 42 in. Wheelabrator Tumblast, with 11½ cu ft capacity, and Bulletin 124-A catalogs the 48 x 42 in. Wheelabrator Tumblast, with 17½ cu ft capacity. Both bulletins are complete with drawings, photographs and data on features, construction and specifications. Available gratis.

Foundry Flask Catalog

OT106—A combination flask catalog and price list, in loose-leaf form with durable binder, has been developed by Black, Sivalls and Bryson to make the ordering of foundry equipment easier for buyers and users. The catalog is divided into three sections for easy reference (1) general information on basic flask construction (2) descriptions and applications of all styles of flasks and flask accessories, and (3) instructions for ordering and order blanks. Flasks are illustrated by 65 drawings and photographs. Catalog will be sent free upon request, and subsequent price changes and flask information will thereafter be sent for insertion into the binder to keep it up to date.

Educational Discussion

OT107—"Foundry Training of Engineering Graduates," a four-page folder recently issued by the Foundry Educational Foundation and reprinted from *The Foundry*, is a synopsis of a panel discussion on "The Employer Looks at the Engineering Graduate," given at the A.F.S. Ohio Regional Foundry Conference, March 11, 1949. In this folder are discussed the experiences of several of the nation's largest and most progressive foundries in training young engineers for the foundry.

Foundry Shakeouts

OT108—Construction features of "Foundromatic" Two-Bearing Shakeouts are described in a new bulletin published by the Allis-Chalmers Mfg. Co. Bulletin 07B6365A depicts such features as resilient springs, pivoted motor base, removable mechanism; steel sand guard; and welded plate steel deck. Eight sizes of shakeout are described ranging from 4 x 6 ft, four-ton capacity, to 8 x 10 ft, 25-ton capacity.

Maintenance Control System

OT109—Preventive maintenance of machines and equipment and the record control system needed to administer such a program effectively are described in a six-page report published by Remington Rand, Inc. The system described is based on a procedure which prompts scientific inspection of machines so as to curtail emergency repairs and facilitate discovery of that point in the performance of any machine where the law of diminishing returns sets in. The folder also outlines how preventive maintenance records may be combined with property records to insure that exactly the right amount of equipment, in top operating condition, is on hand at all times.

Industrial Ovens

OT110—Michigan Oven Co., a new company, describes its line of industrial ovens in a four-page, illustrated folder. Pictured are cabinet type ovens, wicket type conveyor ovens, cross-bar type conveyor ovens, kiln type ovens, monorail conveyor type ovens and flat-deck type ovens. Applications and specifications for each type of oven are given. The company's field engineering survey service is described.

Foundry Equipment

OT111—Profusely illustrated and with a durable spiral-bound cover, Sterling Wheelbarrow Co.'s new 56-page Catalog No. 60 describes Sterling's complete line of foundry equipment. Included are specifications and applications for several types of foundry flasks, flask bars, clamps and clamping bars, steel flask pins, hardened

(Continued on Page 89)

What's the right X-Ray film?

Product:
Gear housing
Material:
Magnesium
Thickness:
Walls varying ¼" to 1"
Equipment:
140-kv X-ray unit

ANSWER:

KODAK INDUSTRIAL X-RAY FILM, TYPE M

In a light alloy casting such as this, the radiographer is interested in discovering microporosity, as well as other irregularities that might be present. This requires the highest possible visibility of detail.

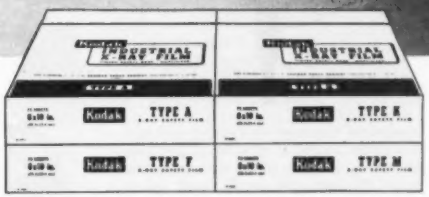
Therefore, Kodak Industrial X-ray Film, Type M, is chosen because this film has the highest contrast and finest graininess of all x-ray films.

RADIOGRAPHY IN MODERN INDUSTRY

A wealth of invaluable data on radiographic principles, practices, and technics. Profusely illustrated with photographs, colorful drawings, diagrams, and charts. Get your copy from your local x-ray dealer—price $3.

Radiography . . .

another important function of photography



A TYPE OF FILM FOR EVERY PROBLEM

To provide the recording medium best suited to any combination of radiographic factors, Kodak produces four types of industrial x-ray film.

Type M provides maximum radiographic sensitivity, high contrast, and exceptional detail under direct exposure or with lead-foil screens. It has extra fine graininess, and the speed is adequate for examination of light alloys at average kilovoltage and for much million-volt radiography.

Type A offers high contrast with about three times the speed of Type M, but with slightly more graininess. Used direct or with lead-foil screens for study of light alloys at low voltages, and of heavy steel parts with 1000-kv x-rays or radium.

Type K has medium contrast with high speed. For gamma ray work and for x-ray work where highest possible speed is needed at available kilovoltage without use of calcium tungstate screens.

Type F provides the highest available speed and contrast when exposed to x-rays with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays, exposed directly or with lead-foil screens.

EASTMAN KODAK COMPANY
X-ray Division · Rochester 4, N. Y.
"Kodak" is a trade-mark

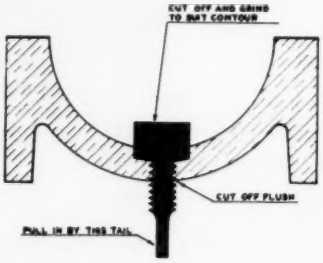
Kodak

NEW Foundry Products

Readers interested in obtaining additional information on items described in New Foundry Products should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the item by means of the convenient code numbers.

Core Box Blow Buttons

OT1—Pullinserts, blast-proof core box blow buttons, are claimed by the manufacturer, Martin Engineering Co., to be a positive stop to abrasion under blow-holes. Made from a tough oil and abrasion-proof



compound, Pullinserts are easily and quickly installed in old or new boxes and guaranteed to stay in place and to outlast metal 10 times. No special tools are required. Hole and thread are standard. Pullinserts are available with heads ¼ or ½ in. thick in sizes from ½ to 2½ in.

Furnace Coating

OT2—Oncrete, an acid and alkali resistant exterior furnace coating is claimed by its manufacturer, Lowebco Co., not to crack, peel, chip or dust off under extreme temperatures. The new coating has a wide variety of other uses for inside and outside applications by factories and industrial plants, such as feed lines, boilers, pumping equipment, storage tanks, filter and refrigeration facilities. The coating can be used on cement floors, storage areas and factory aisle markings, as well as for offices, laboratories and washrooms. Available in black, white and neutral shades, battleship gray, French gray, tile red, Dutch blue, tango red, light and medium green, maroon and buff.

High Speed Grinder

OT3—Designed to operate on 110-130 ac-dc current at 38,000 rpm, the Roto-Master high speed grinder, manufactured by the Metal Removal Co., uses carbide rotary files for roughing and finishing operations. Weighing 12 oz, the grinder operates on an air-cooled motor. Outstanding features include a wrenchless, collettype chuck and sealed microprecision ball bearings with lifetime lubrication. Collets are interchangeable for 3/32 and 1/8 in. Roto-Master is primarily designed for operations requiring fingertip control for precision work.

Magnetic Separator

OT4—Perma-Drum, manufactured by the Dings Magnetic Separator Co., is a non-electric magnetic separator for automatic tramp iron removal which can be installed at discharge ends of chutes, spouts and conveyors. An exclusive circumferential pole design assures uniformity of magnetic field across drum width. Other features: no carryover of magnetic to non-

magnetic discharge; no need for discharge aids; and no drum shell wear from adhering magnetics. Available in more than a dozen sizes, Perma-Drums require no wiring, current consumption or maintenance, and have no dead spots.

Synthetic Resin Binder

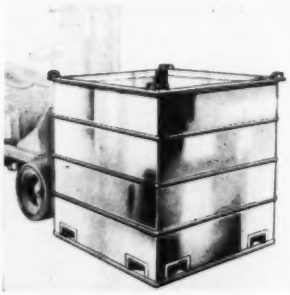
OT5—American Cyanamid Co.'s Cycor Resin 191 is a new liquid, synthetic resin binder for sand cores and dry molds. Cycor 191 can be pumped and/or metered and is otherwise adaptable to existing equipment and methods common to many foundries. This new product is similar to the dry powder Cycor 151 in that it contains no such additives as cereal, fly ash, silica, flour, etc. These lower priced items may, however, be added in the mixer to produce cores of whatever properties the user desires. Cycor 191 is also similar to Cycor 151 in that it produces water-resistant cores which withstand high humidity and long layovers in the mold, and can be cured in either conventional or electronically-heated ovens. Technical bulletin is available.

Industrial Packaging Tape

OT6—Minnesota Mining & Mfg. Co.'s latest addition to its line of industrial "Scotch" tapes is waterproof and has an acetate film backing instead of paper. Designed for packaging metal pipes, rods, ingots, etc., by being wrapped once around the load and back on itself, the tape has a tensile strength of 180 psi and a tear resistance greater than the Elmendorf Tear Tester's 1600 gram-centimeters maximum measurement. Tape requires no application equipment.

Utility Storage Box

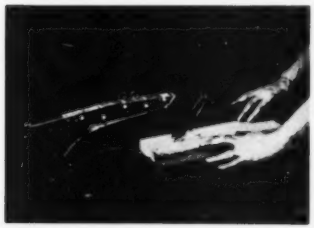
OT7—North American Industries, Inc.'s utility storage box is designed for use with fork trucks, overhead cranes and hand-operated pallet bed trucks. Features include full four-side utility with truck lifting forks, battleship bottom construction, self-positioning stacking lugs, four-corner lifting hooks, lifetime steel construction of 12-gage hard temper steel,



arc-welded joints throughout and full 61 cu ft capacity. Can be used for segregation and storage of scrap metals, as furnace charging boxes, for storage and shipment of castings, and for interplant storage and shipment of turnings, borings, chips, clippings and process scrap metals in the foundry.

Plexiglas Saw Guard

OT8—A transparent saw guard for circular saws of 8 to 20 in. diameter keeps the blade covered at all times, yet allows the operator an unimpeded view of saw



and work. Manufactured by the Laminated Sheet Products Corp. of acrylic plastic plexiglas, the guard is furnished in two styles—Type A for stock of not more than 3 in. thickness, and the double pivoted Type B for thicker stock. A pin arrangement allows the guard to be held in a vertical position for adjustment or changing of blades, yet ready for instant lowering. There is no possibility of the guard's being removed and not replaced. Guard is designed for spreader mounting but is sold without spreader for adaptation to user's particular requirements.

Conveyor Belt

OT9—Ruff Ridge, a new type of conveyor belt manufactured by the Russell Mfg. Co., is molded with a corrugated surface that will raise light goods in cartons or heavy material in bags up inclines of 30 to 40 degrees. The belt combines the chemical and moisture resistance of neoprene with the high physical properties of natural rubber. Abrasion resistance is claimed to be comparable to that of a good tire tread. Made in 250 ft rolls, the belt is available in several thicknesses and in standard widths up to 24 in.

Transverse Test Coremaker

OT10—The Precision Scientific Co. has developed a transverse test coremaker for preparing standard test specimens used in the investigation of core materials and core baking practice. The apparatus is employed in making standard test cores 1 x 1 x 8 in., as recommended by the A.F.S. Committee on Foundry Sand Research. Uniform ramming is obtained by jolting the sand mixture into a core box from a hopper having a height of 3 in. The coremaker has a cast iron base to which four vertical rods are attached to serve as guides for the movement of the block carrying the core box and hopper. Cast aluminum plate on top of block is finished to smooth working surface. Net weight: 75 lb. Dimensions: 20 x 10 x 30 in.

Portable Industrial Mixer

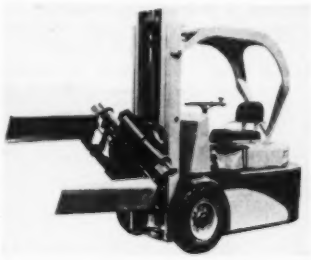
OT11—United Electric Motor Co.'s Marvel Mixer is a belt-type portable industrial mixer designed so that its motor hangs on the outside of the mixing tank—out of the way of fumes and spray—and is so balanced that it requires little pressure to hold it on edge of tank or drum. Interchangeable belts and pulleys make adjustments possible for mixing light, medium or heavy materials. Mixer can be speeded up to whip mixture into a foam, or slowed down to keep solution in suspension. All types of propellers are available in stainless steel, aluminum, bronze, iron, monel or other metals. Mixer is available with either a-c or d-c standard or explosion-proof motors from 1/6 to 3 hp.

Nodular Cast Iron Alloy

OT12—A new magnesium-ferrosilicon alloy for producing nodular graphite in cast iron is now available from the Electro Metallurgical Division of the Union Carbide and Carbon Corp. The alloy contains about 7 to 10 per cent magnesium, approximately 43 per cent silicon, with the balance chiefly iron, and is available in a standard size of ¾ in. by down. According to the manufacturer, results of a large number of tests indicate that the hazards of a magnesium addition are minimized when this magnesium-ferrosilicon alloy is used to produce nodular iron. Since the alloy acts as both a nodulizing and an inoculating agent, often only one ladle addition is required for the production of ductile iron castings. Moreover, magnesium recoveries are said to be comparatively high.

Revolving Load-Grab

OT13—A load grab unit that can be mounted on its 40,000 lb capacity lift truck's revolving apron attachment is announced by the Hyster Co. The load-grab



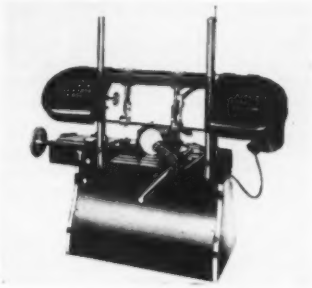
is a hydraulically-controlled device which squeezes its load with sufficient side pressure to allow lifting without need of a supporting pallet. Available for substitution in place of standard load-grab arms are special purpose arms for handling bales, boxes, crates, cartons, drums and barrels. Revolving apron turns loads 190 degrees in one direction, or 95 degrees in either direction. Load-grab capacity ranges from 1930 to 3280 lb.

Foot Disinfectant

OT14—A non-toxic astringent fungicide, developed by the Foam-X Co., is designed to reduce foot infections, such as athlete's foot, in industrial plants and schools. Foam-X is a mild preparation which toughens the skin while destroying fungus growth. Special sponge rubber mats are furnished by the manufacturer for saturation with Foam-X and placement adjacent to showers. A 60-day money-back-guaranteed test is offered by the manufacturer.

Metal Cutting Band Saw

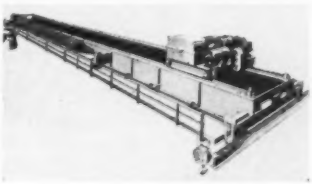
OT15—The Model M metal cutting band saw, manufactured by a new company, W. F. Wells & Sons, is the first of an entire new line of metal cutting saws to be manufactured. Designed to fit the requirements of most cutting jobs, the Model M will also do many milling and planing operations, such as slotting and removing corners of die blocks. Machine raises and lowers hydraulically, eliminating many hand operations and reducing



operator fatigue. Risers of steel, brass and aluminum castings can be cut in instances where use of an upright saw is impractical. Saw has 9 x 18 in. capacity, with 20 in. maximum clearance under saw blade, and swivel vise 45 degrees in either direction. Blade length is 11 ft 5¾ in x .032. in. Saw occupies 20½ x 66 in. floor space. Features: one-piece cutting head, single screw adjustment for rotating blade, quick action vise, tip off block, automatic stock stop and rotating blade brush.

Crane Cab Features

OT16—Three new features recently announced as available for overhead traveling cranes manufactured by the Whiting Corp. are (1) a streamlined Full-Vision Cab, an advanced type of control booth designed to provide maximum comfort for the operator, with the widest possible range of vision. Fingertip levers control all motions, (2) simplified magnetic con-



trollers that insure only low voltage in cab and eliminate use of drum-type controllers, (3) fluid drive (hydraulic couplings) which allow the use of simple, inexpensive electric motors and result in faster pickup and quicker braking.

FOUNDRY FIRM *Facts*

National Radiator Co. of Johnstown, Pa., reopened its Trenton, N. J., plant August 1. Closed in April for lack of business, the opening results from increased orders for cast iron radiators.

Elmes Engineering Division, American Steel Foundries, formerly located in Chicago, has moved to larger quarters at 1150 Tennessee Ave., Cincinnati 29.

United Engineering & Foundry Co., recently held a formal opening of its new general office building at 948 Duquesne Way in Pittsburgh.

Sonith Industries, Inc., Indianapolis, recently completed arrangements with the **Meehanite Metal Corp.,** New Rochelle, N. Y., whereby it will manufacture and sell Meehanite castings.

Jackson Iron & Steel Co., Jackson, Ohio, is now producing a high-silicon iron, Jiscon, which is available to interested foundries on a royalty-free basis. According to company officials, Jiscon has proven highly applicable to the casting of nonferrous pots, molds and stove parts, etc., and experiments are currently under way to determine its application in other casting fields.

Chain Belt Co., Milwaukee, announces the opening of a modern warehouse in conjunction with expanded facilities for the company's district sales office at 1611 Dragon St., Dallas, Texas. Located a short distance from the Dallas business district, the new warehouse insures speedy delivery of chain belt products to industrial and oil-well customers in the Texas area.

Hansell-Elcock Co., Chicago foundry firm, is planning construction of an addition to its plant at 485 West 23rd Place.

H. W. Butterworth & Sons Co., Philadelphia, announces that plans are now under way for construction of a new foundry and additions to its machine facilities at the company's Bethayres, Pa., plant. The building program will increase Butterworth foundry facilities by about 25 per cent. By having foundry and machine shop facilities near to each other, the time element in production is expected to be greatly reduced. When the additions are completed, the company will close its Providence, R. I., plant.

Reynolds Metals Co., Louisville, Ky., announces the appointment of two new distributors for its line of aluminum pig and ingot products. They are: **Brumley-Donaldson Co.,** 3050 East Slawson Ave., Huntington Park Calif., and the **Colonial Smelting & Refining Co.,** Columbia, Pa. These distributors will have available all Reynolds pig and ingot alloys.

Inspecting one of two 85,000 lb molding machines at the Davenport Machine & Foundry Co., Davenport, Iowa, prior to shipment of the machines to the new Societe de Fonderie d'Aluminium et d'Alliages Legers, Arandon, France. Crated for shipment, these machines weighed 100,200 lb each.

American Wheelbrator & Equipment Corp., Mishawaka, Ind., announces the opening of a new sales office in Salt Lake City. The new office will be headed by T. Max Stanger, for two years a member of the company's service engineering staff.

Illustrations in "*Dielectric Core Baking*," AMERICAN FOUNDRYMAN, May, 1949, pages 99-104, show installations of **Induction Heating Corp.** equipment in the **Crompton & Knowles Loom Works,** Worcester, Mass., and **Lehigh Foundries, Inc.,** Easton, Pa.

AVCO MFG. CORP.'s Lycoming and Spencer Heater Divisions were recently merged into a single operating unit, to be known as the **Lycoming-Spencer Divison.** Lycoming-Spencer operations will include production of aircraft engines, precision machine parts, gray iron castings and boilers. The Division will be headed by S. B. Withington, newly-elected vice-president of Avco. Mr. Withington was formerly vice-president and director of Ordnance Steel Foundry, and general manufacturing manager of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. Mr. Withington was also formerly a vice-president of the J. I. Case Co., and was associated with General Motors Corp. and the Ford Motor Co., prior to that.

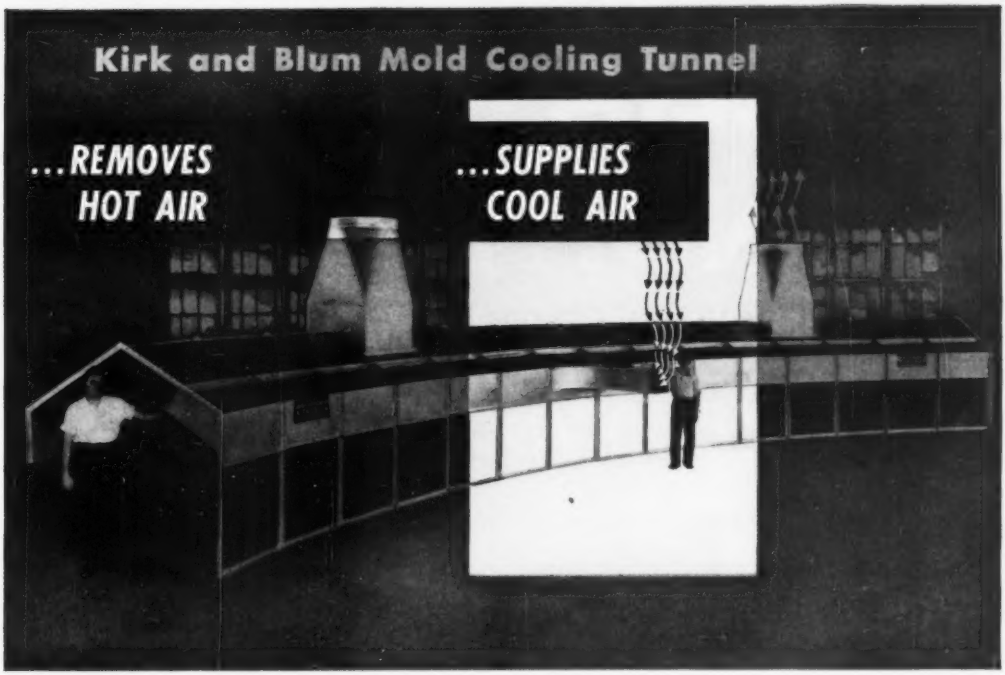
Lead Alloy and Chemical Manufacturing Corp. is the name of a new organization formed by W. P. and Cliff Waller. The company will act as sales agents for cast and extruded solders, tin, lead, zinc, copper, brass ingot, bronze ingot, and aluminum ingots, in addition to smelting, refining and manufacturing allied metal products. The company is located at 1923 Westwood Ave., Cincinnati.

Walsh Refractories Corp., formerly located at 4070 North First St., St. Louis, announces the removal of its offices to 101 Ferry St., St. Louis.

Bellevue Industrial Furnace Co., Detroit, recently introduced a line of Sklenar Type reverberatory tilting furnaces, in capacities of 350 to 20,000 lb.

A metal casting process, claimed to cast, mold, forge and coin a product simultaneously and to eliminate 60 to 70 per cent of the machining operations normally required on a casting application, is announced by **Budds Aero Castings, Inc.** Applicable to the forming of all metals, the patented Bacco process is claimed by Budds officials to increase casting tensile and yield strength from 10 to 40 per cent. The process has already been used successfully to produce Army and Navy ordnance, aircraft and industrial parts. The basis of the process lies in special tools.

(Continued on Page 87)



SOLUTION to the problem of efficiently cooling castings and at the same time, removing hot air, is illustrated here in the plant of National Malleable & Steel Castings Co., Indianapolis, Ind. The "quarter-circle" of hood is supplied with a built-in duct which supplies cool air all along the mold cooling conveyor. This air, drawn from outside the foundry, picks up heat from the castings and is then exhausted outside the building. The hood is supported on just one side so there is minimum interference with trucks on the "aisle side" and cleaning is made easier.

Engineering ingenuity such as this is just one reason why plants . . . large and small . . . in every industry depend on KIRK & BLUM for efficient cooling and dust and fume collection. The 40-year store of experience behind KIRK & BLUM engineering, fabricating and installation service is yours to command; refer your air-handling problems to KIRK & BLUM.

Designed, Fabricated and Installed by Liberty Engineering, Div. Kirk & Blum, Indianapolis, Ind.

FOR CLEAN AIR . . . THE [redacted] TOOL

KIRK AND BLUM

DUST AND FUME CONTROL SYSTEMS

THE KIRK AND BLUM MANUFACTURING COMPANY

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DELTA BONDITE*

FOR *SKIN DRY . . .*
DRY SAND . . .
GREEN SAND . . .
MOLDS AND CORES

THE SUPERIOR, WATERPROOF ORGANIC BINDER THAT . . .

Cuts Production Costs!

DELTA BONDITE, the new waterproof organic binder for skin dry, dry sand and green sand molds and cores is a decidedly superior product . . . immediately available in any quantities . . . and considerably more economical to use.

HERE'S WHY . . .

1. Removal of water by heat produces good tensile strength, very high compression and low hot strength.
2. To produce the above properties, no chemical reaction takes place thus resulting in stable sand surfaces on which the molten metal lays kindly.
3. The volatile gases produced by decomposition of BONDITE, ahead of the molten metal, are reducing in nature. This helps eliminate rough casting surfaces, burning-in and metal penetration.
4. Increased dry strength helps reduce buckling, scabbing, penetration and veining.
5. Prevents surface moisture absorption, becomes waterproof on drying.
6. Withstands high torch heat, will not cause edges of skin dry molds to crumble.
7. It is 98% volatile, leaves no excessive ash for sand contamination.
8. Clays, Bentonite, silica flour, fines or old sand have only a minor effect on its binding properties.
9. It is economical to use, reduces cleaning costs and greatly improves casting surfaces and soundness.

* Covered by U. S. Patents No. 2256832 for foundry use.

Ask for a working sample for test purposes and prove its superior qualities in your own foundry applications.

Complete data and specifications on the use of DELTA BONDITE will be mailed to you on request.

DELTA OIL PRODUCTS CO.

MILWAUKEE 9, WISCONSIN

Mechanize Your Sand Preparation

WITH A

SELF-LOADING

SELF-PROPELLED

ROYER

SAND CONDITIONER

NOT GOOD ENOUGH FOR THE 1949 FOUNDRY TEAM

Hand power has not been able to compete with machinery in most industrial operations. How long do you suppose hand shovelling of foundry sand can compete against the new self-loading, self-propelled ROYER SAND CONDITIONER . . . which turns out 50 tons per hour of molding and core sand . . . sand that is completely trash-free . . . sand that is perfectly blended, cooled, de-gassed . . . ready for immediate use or suitable for storage? If your foundry handles sand in large volume it will surprise you to learn how much less your sand preparation will cost when you use the new ROYER SAND CONDITIONER. We will be glad to send you actual production data for comparison with your own operations. Write today.

ROYER

FOREMOST IN SAND CONDITIONING EQUIPMENT

ROYER FOUNDRY & MACHINE CO.

KINGSTON, PENNSYLVANIA

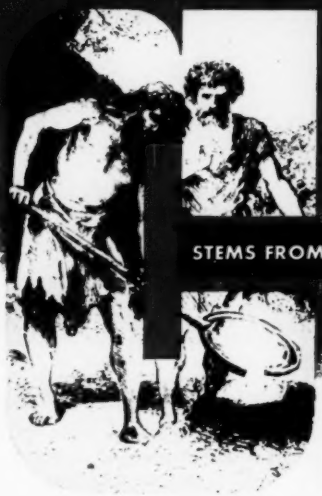
PRIDE OF CRAFT • PRIDE OF CRAFT • PRIDE OF CRAFT

ride of

This history of foundry practice, from the days of prehistoric development of metal to modern castings production, brings into sharp focus the fact confirmed by scientific history . . *progress can be only as swift as research and equipment permit.*

It is the story of man's achievements, through his use of metal, which have contributed so essentially to modern civilization.

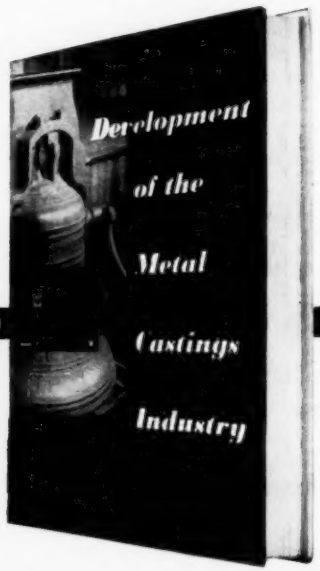
Profusely illustrated, this clothbound, 250-page book enables the modern foundryman to glean a deeper appreciation of the field in which he operates. A combination of fact and romance, "*Development of the Metal Castings Industry*" dramatizes the progress of foundry practice . . . a craft as old as mankind . . . an industry that constantly attunes itself to the needs of modern living.



STEMS FROM AN APPRECIATION OF HISTORICAL BACKGROUND

raft"

- ACCURATE HISTORICAL DATA
- REPRODUCTIONS OF AUTHENTIC AGE-OLD CASTINGS
- STIMULATING RECREATIONAL READING
- CHRONICLE OF A GREAT, WORLD-WIDE CRAFT



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CHAPTER ACTIVITIES

(Continued from Page 65)

patterns. (1) An alloy containing 2.25 per cent beryllium, and (2) A nickel-silicon bronze with 1.8 per cent nickel and .3 per cent silicon.

The beryllium alloy when solution heat-treated and aged produces a hardness of Rockwell C 38-41—similar to white cast iron. The pat tern must be machined after solu tion treatment and before aging because of the high final developed hardness.

The nickel-silicon bronze, which can be easily soldered and brazed has the best wear resistance of any bronze alloy yet encountered for pattern work, Mr. Reid said.

Birmingham District

J. P. McClendon
Stockham Valves & Fittings, Inc.
Chapter Reporter

FUN, FELLOWSHIP and a good time were had by some 700 foundrymen and their friends at the Birmingham District Chapter's 16th Annual Outing, held September 3 at the Roebuck Country Club.

A day-long, fully-rounded program offered a wide choice of entertainment. Golf, swimming, group games and just plain relaxing under the tall, whistling pines preceded one of the finest barbecue dinners ever served by the Chapter.

Chairman of the committee in charge of the outing was E. A. Brandler of the Electro Metallurgical Division of the Union Carbide & Carbon Corp. He was assisted by C. K. Donoho and E. M. Whelchel of the American Cast Iron Pipe Co.; R. W. Sandelin and Joseph R. Gilbert, Stockham Valves & Fittings, Inc.; and Warren Jeffrey, Jackson Industries, Inc. Assisting in organizing the program were A. S. Holberg of Birmingham; Howard Nelson, Hill & Griffith Co.; Harold Johnson, Jackson Industries, Inc.; and W. Guy Bagley, Woodard Iron Co. Ray F. Frings, Central Foundry Co.; and M. L. Carl, Sloss-Sheffield Steel & Iron Co., did an excellent job of distributing tickets.

The Annual Outing was the initial meeting of the Chapter for the 1949-50 season.

Vice-Chairman Morris L. Hawkins, Stockham Valves & Fittings, Inc., who is in charge of monthly

Announcing an
IMPORTANT IMPROVEMENT
in POURING EQUIPMENT

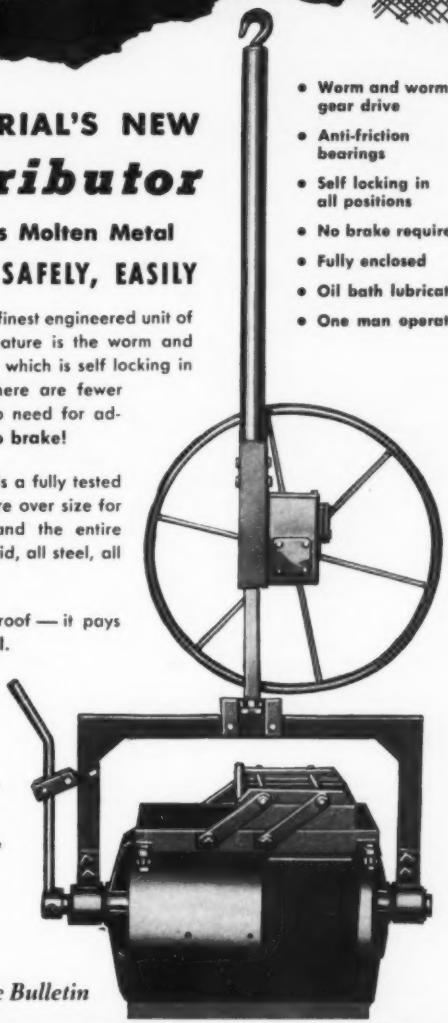
INDUSTRIAL'S NEW
Distributor
Distributes Molten Metal
QUICKLY, SAFELY, EASILY

- Worm and worm gear drive
- Anti-friction bearings
- Self locking in all positions
- No brake required
- Fully enclosed
- Oil bath lubrication
- One man operation

Here it is — the finest engineered unit of its type. Key feature is the worm and worm gear drive which is self locking in all positions. There are fewer moving parts, no need for adjustment, and no brake!

The **Distributor** is a fully tested unit. All parts are over size for extra strength and the entire assembly is a rigid, all steel, all welded unit.

Here again is proof — it pays to buy **Industrial**.



SIZES:
The Industrial **Distributor** is available in 700# and 1500# capacities. 2, 2½, and 3 ft. lifts available in each size.

**Write for Descriptive Bulletin*

Industrial EQUIPMENT COMPANY
115 N. OHIO ST. MINSTER 2, OHIO

Prompt shipment—unlimited quantities now available to foundries from BAROID—the world's largest producer of Bentonite. Our modern plants are geared to fulfill every requirement of the foundry trade.

From THESE APPROVED DISTRIBUTORS

American Cyanamid Co.
New York, New York

The Asbury Graphite Mills, Inc.
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Barada & Page, Inc.
Kansas City Missouri (main office)
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McConnellsville, New York

Canadian Industries, Ltd.
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The Foundries Materials Co.
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Pennsylvania Foundry Supply & Sand Co.
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Robbins & Bohr
Chattanooga, Tennessee

Smith-Sharpe Company
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Southwest Foundry Supply Co.
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Mr. B. J. Steelman
Chicago, Illinois

Stoller Chemical Co.
Akron, Ohio

Wehenn Abrasive Co.
Chicago, Illinois

Mr. Walter A. Zeis
Webster Groves, Missouri

BAROID
SALES DIVISION
NATIONAL LEAD COMPANY

BENTONITE SALES OFFICE:
RAILWAY EXCHANGE BLDG.
CHICAGO 4 • ILLINOIS

programs, has announced that regular meetings will be held in the Tutwiler Hotel, Birmingham, on the third Friday of each month, except during February. The Annual Birmingham Regional Foundry Conference will be held February 2-4, 1950.

N. Illinois-S. Wisconsin

Jerry M. Zilka
Gunite Foundries Corp.
Technical Secretary

THE FIRST MEETING of the season was held at the Bel-Mar Country Club, Belvidere, Ill., September 12. Chapter Chairman L. C. Fill, George D. Roper Corp., Rockford, Ill., presided at the meeting.

Speaking on *"Inspection Procedures,"* A. M. Hermann, Belle City Malleable Iron Co. and Racine Steel Castings Co., Racine, Wis., outlined briefly the practices followed by his company to insure the control of quality. The company's program makes use of statistical methods wherever possible. Being a fairly new tool as far as foundries are concerned, the talk was of interest to all.

Control of quality at Belle City, the speaker said, is maintained by vigilant inspection. It begins with the pattern equipment and core boxes. They are checked for layout against the company's blueprints. Following this, samples are made and checked dimensionally against the blueprints. When the pattern has been inspected and approved the pattern is run on trial and the castings subjected to x-ray, visual or destructive inspection.

In the coreroom, cores are inspected at various stages of production either visually or with hardness testers or with gages and templates. This includes spot checks on green cores, baked cores, and core assemblies. Core driers are also subjected to inspections and corrections at regular intervals.

Inspection procedures have also been established on the molding floors. Here foremen take care to check on mold hardness, core setting, and pouring practices. In the inspection department records are kept on all jobs with regard to location points and other customer requirements. Such information is obtained by personal contact with the customers.

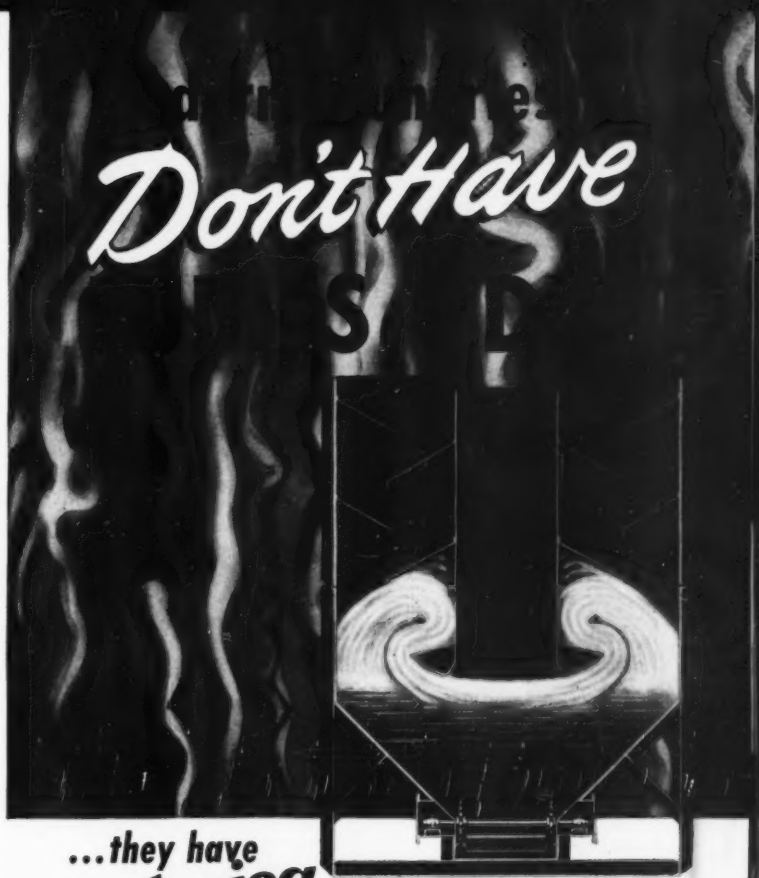
Supervisors and chief inspectors

make regular visits to customers to iron out difficulties that may arise and to insure that the customer's requirements are understood and met. If a question should arise regarding a casting, the inspection department refers the question to the supervisor or inspector for action. He will either know the answer from his knowledge of the customer's requirements or make it a point to find the answer. Gages, templates, and checking fixtures are inspected periodically and repaired.

Quality control meetings are headed daily by the inspection department and attended by supervisors and foremen. Scrap records for the previous day are reviewed. Scrap castings for the previous day are displayed where all persons concerned with the making of the castings can see them. Scrap that is assignable to a molder is reviewed by the molder and foreman. Thus the company, in the opinion of Mr. Hermann, is producing castings of a higher quality than before.

Earlier in the day, despite a continuous rain, many members accepted the invitation of Arthur Rose, of National Sewing Machine Co., Rockford, to visit the company's recently-improved foundry.

Ontario Chapter Chairman Jack H. King (left), Werner G. Smith Co., Ltd., Toronto; Host Rolph Barnes, (center) Wm. R. Barnes Co., Ltd.; and U. S. Visitor Clyde A. Sanders, American Colloid Co., Chicago, at the Ontario Chapter's Annual Picnic, held at Mr. Barnes' estate, near Waterdown, Ont., on August 27.



...they have Schmieg CENTRI MERGE

Available both as a floor-mounted type (shown) or an overhead installation. Complete with a motor-driven sludge removal conveyor, where required.

AUTOMATIC ELIMINATION
from Collection to Disposal

Operators of modern foundries have long since learned the economy of ridding their shops of destructive dust and smoke fumes. Men who work in foundries free of these health hazards feel better, work better, produce more. And the accident rate is lowered. In actual foundry operation, the Schmieg CENTRI-MERGE method of dust and fume elimination has shown marked advantages over any other system. Dust and fumes are collected *immediately they occur*—shot back on a stream of air through ducts to the Collection Unit. In the washing chamber of this unit—a veritable tornado of seething, churning water-dust is washed and scrubbed from the air and flooded into the sludge tank below, permanently trapped under water. Fumes go out the exhaust. AUTOMATIC operation from start to finish.

If you are interested in learning why the CENTRI-MERGE method is so highly endorsed by foundry owners and how its application can so greatly benefit your own operation, our engineers are prepared to give you some eye-opening information on dust and fume elimination—without obligation, of course.

THE best AIR PURGE is CENTRI MERGE

Schmieg INDUSTRIES INC.
Engineers & Manufacturers

308 PIQUETTE AVENUE

which has undergone extensive mechanization and modernization in recent months.

Chicago

The Annual Stag Outing and Golf meeting of the Chicago Chapter was held August 13 at the Lincolnshire Country Club, Crete, Ill. Features of the Outing were golf, a weight-guessing contest, a horseshoe pitching exhibition by world's champions, a fried chicken dinner and entertainment.

Headed by R. M. Jones of the Carnegie-Illinois Steel Corp., the Chapter's Entertainment Committee consisted of: H. E. Cullen, Carnegie-Illinois Steel Corp.; J. Behen, National Carbon Co.; George Biddle, Illinois Clay Products Co.; R. Burnell, The Federal Foundry Supply Co.; F. B. Flynn, S. Obermayer Co.; J. C. Gore, Werner G. Smith Co.; C. C. Kawin, C. C. Kawin Co.; T. J. Magnuson, J. S. McCormick Co.; S. E. McGinty, Firegan Sales Co.; N. L. Mooneyham, The Trabon Co.; B. A. Patch, Ohio Ferro Alloys Corp.; H. J. Pfeiffer, Electro Metallurgical Sales Corp.; E. C. Reimann, Wisconsin Steel Co.; H. G. Schlichter, Beardsley & Piper Division, Pettibone Mulliken Corp.; E. W. Smith, Western Materials Co.; H. C. Swanson, Arrow Pattern & Foundry Co.; and H. K. Swanson, Swanson Pattern and Model Works.

Brief Notes for Busy Foundrymen

Physical Properties of Southern Bentonite

Panther Creek bentonite is a high-powered bonding material. It is many times stronger than fire clays and the clay materials contained in natural molding sand. A little of it goes a long way in furnishing green strength to foundry sands. We are introducing to you the physical properties and facts of this bond.

Higher Green Strength

Panther Creek yields higher green strength than Volclay and other western bentonites by a wide margin, especially when the sand is worked with low moistures.

Lower Dry Strength

Panther Creek has lower dry strength than Volclay, which eliminates sand from caking and becoming lumpy, thus saving time, labor, and loss of sand in the system.

Hot or Retained Strength

Panther Creek has lower hot or retained strength than Volclay or other western bentonites, thus eliminating hot tears or cracks in castings when the sand must give way to accommodate for shrinkage during solidifying and cooling of the metal. This is its most distinct and unusual advantage.

Flowability

Panther Creek rebonded sands are noted for high flowability as the sands are less gummy and Panther Creek is non-swelling. Metal penetration is less likely to occur as fewer sand voids are present.

Permeability

Permeability is slightly less with Panther Creek than with Volclay due to better flowability furnished by Panther Creek. The difference is not sufficient to offer as an advantage or a disadvantage.

Sintering Point

Both Panther Creek and Volclay have a very high sintering point, better than nearly any other kind of bond clay. The surface finish of a casting is greatly influenced by the sintering point of the sand in which it is cast. Sand with a high sintering point does not burn-on but peels nicely leaving a smooth finish on the metal and reduces cleaning cost.

Expansion and Contraction

A low volume change is desired. In a shock test at 2500° fire clays and natural molding sands expanded the most, Volclay next and Panther Creek the least. On contraction after heating, fire clays and natural molding sands contract the most, Volclay next, and Panther Creek the least. Panther Creek may be considered the best in this respect, Volclay second best.

Write for complete or specific information on Panther Creek applications

Our New Address: Merchandise Mart Plaza • Chicago 54, Illinois

VOLCLAY Western Bentonite • FIVE STAR Wood Flour • PANTHER CREEK Southern Bentonite

AMERICAN COLLOID COMPANY Chicago Illinois • Productive Clays 1927

Available from Leading Foundry Suppliers in the United States and Canada

Western Michigan

Rolfe Jenkins
Campbell, Wyant & Cannon Foundry Co.
News Editor & Photographer

OPENING THE 1949-50 SEASON, George K. Dreher, executive director, Foundry Educational Foundation, spoke at the October meeting, held at the Cottage Inn, Muskegon.

Speaking on *"Youth Encouragement,"* Mr. Dreher directed his words to students of the Hackley Manual Training School Foundry course and their instructor, Adrian J. Archambault, as well as to regular members and their guests.

Mr. Archambault described briefly the organization, procedure and purpose of the school, which made a fresh beginning early this year after undergoing modernization.

The students took an active part in the discussion which followed Mr. Dreher's talk.

The A.F.S. research film *"Fluid Flow in Transparent Molds"* was shown following the discussion.

Chapter Chairman C. N. Jacobson, Dake Engine Co. conducted a brief business meeting at which Secretary Ross P. Shaffer, Lakey Foundry and Machine Co. and Treasurer Laurin D. Ramsey, Paul M. Wiener Foundry Co. made reports covering the annual picnic

Northern California

Milton Oakes
American Manganese Steel Division
Publicity Chairman

THE FIRST MEETING of the '49-'50 term was held at Pland's Broadway Restaurant, Oakland, September 14.

Chairman James Francis, Vulcan Foundry Co., Oakland, introduced the new officers, directors, and committee chairmen.

The guest speaker, F. G. Sefing, International Nickel Co., New York, spoke on *"Selling the Value of Castings to Engineers."* He discussed the problem from quality and design points of view, the necessity of close cooperation with cus-

tomers to insure fulfillment of their requirements, and the advantages of the foundryman being his own sales engineer.

Norman Schlagel of Vulcan Foundry Co. won the door prize (two tickets to the Cleveland Browns-Forty Niner football game).

Canton District

Paul H. Muntz
United Engineering & Foundry Co.
Chapter Secretary

THE ANNUAL PICNIC, held at the Alliance Country Club, Alliance, Ohio, September 10, was attended by more than a hundred foundrymen and guests of the Chapter.

Golf, baseball, horseshoes and other sports preceded the evening's dinner and entertainment. Prizes were awarded winners of the sports events and door prizes given during the dinner. The Picnic was one of the most successful ever given by the Chapter and credit for its success is largely due to the Entertainment Committee.

Tennessee

Carl A. Fischer, Jr.,
Fischer Supply Company
Chapter Reporter

THE ANNUAL BARBECUE SUPPER was held at the Signal Mountain Golf and Country Club, Signal Mountain, Tenn., August 27.

Golf, swimming, horseshoes, soft-ball, darts, and other games were on the all-day program. Supper was served at 5:00 P.M. consisting of barbecued pork and beef, potato chips, slaw, bread, and coffee. As usual, the barbecue was excellent and thoroughly enjoyed by all. The drawing for door prizes was made during supper.

Credit for the highly successful outing was due to the efforts of Fred H. McGee, Fanner Mfg. Co., J. B. Mullenix, Equipment & Supply Co., and Herbert W. Dent, Mfrs. Equipment & Supply Co.

Quad City

R. E. Miller
John Deere Planter Works
Moline, Illinois

More than 100 foundrymen opened the new chapter year listening to lead-off man Nelson S. Mosher of Alloy Metal Abrasive Co. His subject for the technical session was the *History and Development of Steel Shot for Clean-*

Operator using the new Model No. 1506 low speed polisher. Section of laboratory equipped with No. 1251 Duo Belt Sander —No. 1700 Electro Polisher— No. 1315 Press.

1505-2AB Low Speed Polisher

THE BUEHLER LINE OF SPECIMEN PREPARATION EQUIPMENT INCLUDES . . . CUT-OFF MACHINES • SPECIMEN MOUNT PRESSES • POWER GRINDERS • EMERY PAPER GRINDERS • HAND GRINDERS • BELT SURFACERS • MECHANICAL AND ELECTRO POLISHERS • POLISHING CLOTHS • POLISHING ABRASIVES.

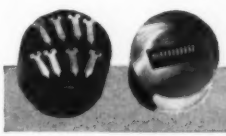
. . . provides the metallurgist with the most complete line of modern designed precision machines for specimen mounting and preparation available anywhere in the world. This finely made equipment has been developed through a thorough understanding of the requirements of the metallurgist and a rigid insistance on perfection in the mechanical design and construction of each item.

Everything needed for metallurgical testing from cut-off machines, moulding presses, and grinders to the mechanical or electrolytic polishers is included in the Buehler line.

In setting up complete laboratories or adding items to present equipment the metallurgists will find in the Buehler line of coordinated equipment everything needed for producing the best work, with speed and accuracy.

Write for bulletin of new equipment or information on any specific item. We invite correspondence relative to setting up complete laboratories suitable for any particular requirement.

Exclusive U. S. agents for Amsler and Chevenard Testing Machines.



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A PARTNERSHIP
METALLURGICAL APPARATUS
165 WEST WACKER DRIVE, CHICAGO 1, ILLINOIS

"A CLEAN FOUNDRY is an efficient foundry." Everything in its place, ample room to move about in handling the work. Accidents minimized, output increased, you can well visualize the steady, uninterrupted pouring of metal in a plant like this.

On this point Crucible Melters' Handbook may help you: a handy little volume that is intensely practical. Sent free, of course. Just write for it.

*Plenty of room to move through unobstructed aisles makes it easy to pour directly from the crucible that only a few moments before was in the furnace. U. S. Naval Gun Factory, Washington, D. C.

CRUCIBLE MANUFACTURERS ASSOCIATION
140 CEDAR STREET
NEW YORK 6, N.Y.

ing." Mr. Mosher, a pioneer in this field, compared conclusively the various materials used for shot.

The early research, according to Mr. Mosher, showed disagreement and confusion in shot classification. This was remedied by setting up standards for suppliers to meet.

The new board of directors met with Chapter Chairman E. P. Closen, John Deere Planter Works, Moline, Ill., for a short business meeting. The Christmas party was discussed at some length, and the date, December 9, announced.

Central New York

John A. Feola
Crouse-Hinds Co.
Publicity Chairman

THE OPENING DINNER meeting of the 1949-50 season, held in the Hotel Utica, Utica, September 9, was attended by 75 members and their guests.

Chapter Chairman J. F. Livingston, Crouse-Hinds Co., Syracuse, presided at the business meeting, calling upon Past Chapter Chairman C. M. Fletcher, Fairbanks Co., Binghamton, to present suggested changes in Chapter by-laws.

E. E. Hook, Dayton Oil Co., chairman of the New York State Regional Conference, outlined the program for the two-day conference, to be held November 25 and 26 at Syracuse University, Syracuse.

Highlights of the conference will be a demonstration of nodular iron vs. untreated gray iron bars; a general session on latest developments in nodular iron; sessions on malleable iron, non-ferrous, steel, sand and motion and time study.

W. B. McFerrin, Electro Metallurgical Division, Union Carbide & Carbon Corp., Detroit, spoke on *"Gray Iron Casting Defects,"* opening his talk by presenting a chart showing 30 defects and their causes. This chart also showed that many of the defects were caused by the same factor.

The speaker then showed a series of slides depicting four of the more frequently-encountered types of casting defects—shrinkage, blows, scabs and rat-tails. He identified each defect as it was shown, explaining its cause, and describing steps to be taken to overcome the fault. A lively discussion period followed Mr. McFerrin's talk.

PERSONALITIES

(Continued from Page 69)

Herbert J. Bauman, formerly foundry superintendent for Ehaloy Foundries, Inc., Rockford, Ill., has been appointed core room foreman for the National Sewing Machine Co., Belvidere, Ill. Mr. Bauman is immediate past chairman of the A.F.S. Northern Illinois-Southern Wisconsin Chapter.

A. J. Ricker, one of the founders and president of the Badger Malleable & Manufacturing Co., South Milwaukee, Wis., retired from active service August 31 after 31 years with the company. On July 1, new officers of the company elected were: **C. M. Lewis,** president; **T. E. Ward,** secretary and treasurer; **Leo Joerg,** assistant secretary; and **A. F. Schwan,** assistant company treasurer.

Andrew Hayes, pattern shop foreman for the Whiting Corp., Harvey, Ill., recently retired after 34 years with the company. Mr. Hayes first began work as a handy man in 1915 in the same department. Another old-time Whiting employee to retire recently was Edward Schroeder, machine shop foreman who started with Whiting as a shop sweeper in 1899.

Harold B. Staniar has been appointed to the sales staff of J. M. Barclay, Inc., Newark, N. J., sales representative for the Automatic Transportation Co., of Chicago. Mr. Staniar will handle the company's Union County, N. J., territory.

D. B. Hendryx, for 21 years chief engineer for the Harbison-Walker Refractories Co., Pittsburgh, resigned effective September 20 to establish his own engineering and consultant service. Mr. Hendryx will also do some consulting work for Harbison-Walker. He will be succeeded as chief engineer by **R. P. Snyder,** who has been associated with Harbison-Walker and Northwest Magnesite Co. for 16 years.

Willis G. Sullivan, Milwaukee corporation lawyer, was recently named vice-president and general manager of the Chas. A. Krause Milling Co., Milwaukee. Mr. Sullivan, who has been legal counsel for Krause since 1931 and a director of the company for several years, was named secretary of the company last spring. He is a graduate B.A. and LL.B. of the University of Wisconsin. Mr. Sullivan has been practicing law in Milwaukee since 1927, and has served the state as special counsel for utility and railroad tax cases.

Donald F. Lane, director of training for the Bethlehem Steel Co.'s Sparrows Point, Md., plant, was recently appointed training director for plants of Lever Bros. Co., internationally-known soap manufacturing concern, effective September 18. Mr. Lane, who will make his headquarters in the company's offices at Cambridge, Mass., has for many years been prominent in work of the A.F.S. Educational Division, having served on the Division's Program and Papers Committee, Foreman Training Committee, and as Vice-Chairman of the Apprentice Training Committee.

John J. Jackson has been appointed superintendent of the Wright Aeronautical Corporation's foundry at Wood Ridge, N. J., succeeding the late Harry Lamker, A.F.S. National Director who died this summer after heading the Wright foundry for more than 25 years.

Richard A. Larson, formerly foundry metallurgist and sand technician at the Beloit, Wis., Works of the Fairbanks, Morse Co., has joined the sales engineering staff of the Foundry Supply Co., Minneapolis. Mr. Larson will handle sales of refractories and foundry sands in Iowa and Minnesota.

Lloyd B. Marshall, who graduated this spring from the Massachusetts Institute of Technology with honors, was recently appointed a foreman at the Dayton Malleable Iron Co., Dayton, Ohio. Mr. Marshall served overseas during World War II as a combat infantryman and was awarded the Army's Bronze Star and Silver Star.

Joseph Graziano has been appointed assistant manager at the Newark, N. J.,

IT'S BUCKEYE PROFITABLE, LONGER LASTING CUPOLA BLOCK

Foundrymen know that Buckeye Silica Firestone is the ideal refractory for lining and patching the melting zone of cupolas.

Low in first cost, Buckeye is quickly and easily installed by anyone and has a life from 200% to 400% longer than average.

These are facts that can be substantiated by a trial installation of Buckeye. Why not have our engineers call, at no obligation?

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REFRACTORY DEPT.
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Send for free Bulletin 63

BUCKEYE
"FOR THAT EXTRA SERVICE"
SILICA FIRESTONE

TEPCO

FERRO-SILICON BRIQUETTES

Tepco Ferro-Silicon Briquettes, used mainly for the addition of silicon to the cupola charge of iron foundries, are most convenient because they contain a certain definite weight and can be counted instead of weighed. At the same time, the briquettes are more valuable than lump ferro-silicon because the binder in the briquettes protects the ferro-silicon as it is melted in the cupola and a greater return of silicon is obtained by that means.

Tepco Ferro-Silicon Briquettes are produced at our Chattanooga plant (formerly Southern Ferro-Alloys Company, Chattanooga, Tennessee). The 2½-pound briquettes contain one pound of silicon and the 5-pound briquettes contain two pounds of silicon.

Tepco Ferro-Silicon is also available in all sizes from lump through 150 mesh by down, packaged or in bulk—50%, 65% and 75% standard and low impurity grades. Special grades and sizes quoted on request.

PIG IRON

Tepco's high-grade pig iron includes two preferred types:

Diamond D Pig Iron — low-phosphorous, low-silicon, high-carbon, machine cast — preferred for Nodular Graphitic Cast Iron and all White Iron Castings.

Rockwood Pig Iron — malleable and foundry, .15 to .30% phosphorous, machine cast — preferred for automotive, malleable, and general castings.

FOUNDRY COKE

Radiant By-Product Foundry Coke — produced from properly blended coals to furnish high-grade foundry coke. Widely used by foundries in the Southern area. Radiant Coke also available in smaller sizes.

We will be glad to discuss with you, at any time, the numerous advantages of our plants and products.

TENNESSEE PRODUCTS & CHEMICAL CORPORATION

GENERAL OFFICES: NASHVILLE, TENNESSEE

PLANTS AT CHATTANOOGA, ROCKWOOD AND WRIGLEY, TENN.

Represented by

MILLER & CO., Chicago, St. Louis, Cincinnati; S. H. BELL CO., Pittsburgh; T. H. BENNERS & CO., Birmingham

EXPORT AGENTS: ORE & FERRO CORPORATION, 30 Broad St., New York

plant of the Federated Metals Division of the American Smelting & Refining Co. Simultaneously, **James F. Orr** was promoted to the post of plant superintendent, succeeding **E. R. Marble, Jr.**, who was recently transferred to the company's Central Metallurgical Department. Mr. Graziano has been with Federated since 1930, starting as an office boy. Mr. Orr began with the company as a chemist.

F. S. Kleeman, a partner in the New Castle Foundry Co., New Castle, Pa., was recently appointed technical editor of *Industrial Heating*, published by the National Industrial Publishing Co., Pittsburgh. Prior to becoming a partner in the New Castle Foundry Co., Mr. Kleeman

F. S. Kleeman

served as chemist and engineer in several foundries in Missouri, Illinois and Pennsylvania. He has spoken before A.F.S. Chapters and the Pittsburgh Foundrymen's Society on metallurgy and foundry sand practice.

David M. Whyte, formerly head of D. M. Whyte & Associates, Mt. Vernon, Ohio, foundry consultants, has acquired an interest in Bellville Foundries, Inc., Belleville, Ohio, and has been elected secretary-treasurer and general manager of that organization. Mr. Whyte was at one time general foundry superintendent of the Grove City, Pa., and Mt. Vernon, Ohio, plants of the Cooper-Bessemer Corp.

E. L. Graham, owner and founder of Acme Foundry & Machine Co., Coffeyville, Kan., has retired after 35 years and his son, with the company 20 years, has assumed active management. The elder Graham retains the title of president while the son, **G. H. Graham,** formerly vice-president and secretary, is now secretary and manager. New vice-president is **Fred E. Fogg** who was formerly sales engineer for the company.

OBITUARIES

J. Ovide Bertrand, secretary and manager of La Compagnie Dussault & Lamoureux St-Hyacinthe, St-Hyacinthe, Quebec, Canada, died February 17. Prior

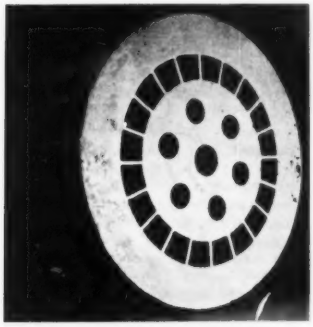
(Continued on Page 90)

FIRM FACTS

(Continued from Page 74)

whose temperatures are thermostatically controlled and which allow metal to be poured in a liquid state while pressure is applied continuously to the point of solidification. Castings can thus be made to tolerances of .001 to .002 in., eliminating 60 to 70 per cent of machining operations and giving consistent physical properties, company officials state.

Shawinigan Chemicals, Ltd., Montreal, recently cast a blower rotor, the largest stainless steel casting ever made in Canada, for the **Nash Engineering Co. of Canada, Ltd.** Weighing 6400 lb after machining, the rotor was cast from Shawinigan's



standard KA2MO (Composition: carbon—.10; chromium—19.0 to 20.0; nickel—9.0 to 10.0; molybdenum 2.75 to 3.25—with manganese, silicon, phosphorus and sulphur in the usual amounts. The blower was made according to Nash Engineering's specifications. Several castings were made in the 6400 lb size and several in smaller sizes for use in chemical plants.

The annual 25-Year Club Outing of the **Norton Co.,** Worcester, Mass., was recently attended by more than 800 quarter-century company veterans. This year, 61 new members were inducted into the club at ceremonies which included presentation of gold medals and watches and certificates of service.

Davenport Machine and Foundry Co., Davenport, Iowa, recently installed two giant molding machines and other equipment in a new French foundry—**Societe de Fonderie d'Aluminium et d'Alliages Legers,** at Arandon, France. The plant will make large aluminum castings for the manufacture of a 4 hp auto chassis. The plant when completed will be equipped with a pattern shop and melting, molding, heating and laboratory departments.

Gould Storage Battery Corp., Trenton, N. J., invites all companies utilizing motive power storage batteries for industrial trucks to send their battery maintenance supervisors, materials handling

LOWEST COST PORTABLE MULLOR

THE MULBARO

Mulling mechanism is raised and lowered by auxiliary hoist permitting several barrows to be used alternately.
Top portion contains entire mulling mechanism: totally enclosed motor, gear case, mulling wheels and plow.
Plow bleads and directs sand into path of rubber tired mulling wheels where it is thoroughly mulled.
Available in two sizes: 3½ and 7 cubic foot batch capacities.
1. Sand shoveled into Mulbaro's knee-high barrow.
2. Barrow easily wheeled to mulling mechanism.
3. Barrow positioned under mulling mechanism.
4. Mulbaro quickly and thoroughly mulls.
5. Mulling mechanism raised from barrow.
6. Mulled sand wheeled to molder or coremaker.
Less sand handling—sand is loaded only once—into the knee-high barrow. After mulling, sand is carried in same barrow, directly to molder or coremaker.

The *really* portable Mulbaro is easily moved about the foundry or core room and the sand is mulled in the same barrow in which it is brought to and taken from the mullor. The sand is handled only once! With an additional barrow or barrows, the Mulbaro mulls almost continuously. While the sand is being mulled in one barrow another is being loaded or unloaded. Thus the Mulbaro offers the capacity of two or more mullors for slightly more than the price of one . . .

Beardsley & Piper are manufacturers of the Sandslinger • Speedslinger • Hydro-Slinger Speedmuller • Mulbaro • Screenerator • Nite-Gang • Junior Nite-Gang • Preparator • Champion Speed-Draw • Plate Feeders • Turntables • Gyratory Screens.

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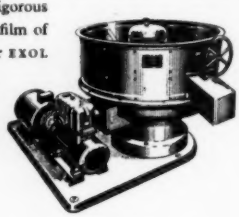

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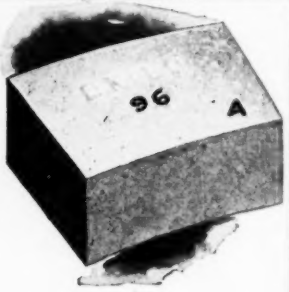

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engineers and others who are engaged in the operation of storage batteries to its annual five-day storage battery school, to be held in Trenton, November 14-18. The course, whose purpose is to aid industry to get maximum efficiency and life from storage batteries, will cover battery theory and design, electrical theory, battery layout, charging methods and maintenance procedures. The course will feature 17 lectures and laboratory demonstrations. Tests are given and diplomas awarded at the end of the course. Companies will be required to pay their representatives' expenses, with the exception of lunches, which will be furnished by Gould. Bulletin and further details are available from J. A. Gilruth, School Director, Gould Storage Battery Corp., Trenton, N. J.

The Ramtite Co. announces the establishment of a direct branch office with complete warehouse stocks of foundry refractory materials at 1530 River Bed Ave., Cleveland, 13, Ohio. Joseph J. Moore will be in charge of the new office.

Lebanon Steel Foundry, Lebanon, Pa., announces the development of a new alloy steel capable of fulfilling engineering requirements at −423 F. This austenitic cast ferrous alloy contains 19.50 per cent chromium and 9 per cent nickel, among other alloying constituents, and is designed to meet exacting requirements of the oil, chemical and processing industries. The alloy has already been used in producing steel castings for pressure equipment in storage facilities for liquid oxygen, a rocket engine propellant. The alloy has shown no structural changes down to −423 F in hundreds of impact tests from production lots of (L)-22 castings, and tests indicate that hardness increases in direct proportion to temperature decreases. Tensile strength varies inversely with temperature, but ductility is lowered to a lesser degree. The alloy can be easily welded by either gas or electric processes, and has also proven successful in engineering applications calling for resistance to extreme heat.

OTS To Continue Basic Technical Information Service

INCREASED APPROPRIATIONS enable the Office of Technical Services of the U. S. Department of Commerce to continue its basic technical services for industry during the coming 12-month period, according to Director John C. Green.

The OTC will attempt to broaden its services to industry, particularly by serving as a source of technical information for such firms as do not have their own laboratories or sufficiently elaborate technical facilities.

In line with its expanded policies, the OTC has halved the price of yearly subscriptions to its *Bibliography of Technical Reports*, a monthly journal of technical reports, to $5. A newsletter is also being published monthly, highlighting business opportunities arising from developments made through research.

LITERATURE

(Continued from Page 70)

steel bushings, stub pins, collar bushings, core plates, bottom boards, bands and upsets, wedges, wheelbarrows, carts, core trucks and slag buggys.

Grinding Chucks and Segments

OT112—A four-page illustrated folder recently released by the Sterling Grinding Wheel Division of the Cleveland Quarries Co. describes the Sterling line of No. 2 Chucks and Segments.

Battery Maintenance Reprints

OT113—Reprints of articles on battery maintenance appearing in current trade and technical magazines are available free-of-charge from the Gould Storage Battery Corp. Articles on the maintenance of both cycle-duty batteries and stationary batteries are available for use on bulletin boards, as instruction sheets, and as reference material. Stationary battery reprints contain information on both installation and maintenance techniques. Illustrations, one of which is a typical stationary type record card, are included. Cycle-duty battery reprints discuss eight primary rules of battery maintenance. Illustrations include photos demonstrating several of these rules and a reproduction of a typical cycle-duty record card.

Spark-Arc Source Unit

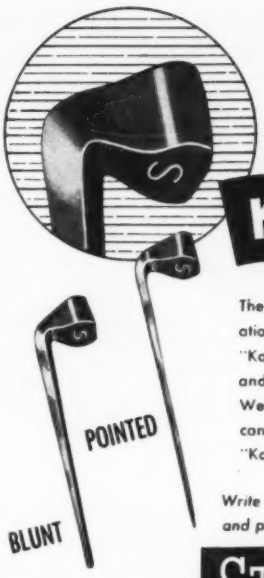
OT114—Designed by Applied Research Laboratories, a new spectrographic source unit provides routine control laboratories with a relatively inexpensive dual-purpose source. The Spark-Arc Source Unit is built to fill the requirements of most laboratories for two source units—one for the precision analysis of elements at higher concentrations, and a second for high-sensitivity trace analysis.

Portable Air Compressors

OT115—Two dual-pressure, low-cost portable air compressors are announced by the American Brake Shoe Co.'s Kellogg Division. Model B-140-DS is powered with a ½ hp electric motor, and Model G-140-DS with a ¾ hp gasoline engine. Both models operate at 150 lb pressure, delivering 3.2 cfm free air for paint spraying, and many other uses requiring low pressure and increased volume. Both models are easily portable, with or without two-wheeled rubber-tired cart.

Dust Control Equipment

OT116—Pangborn Corp.'s Bulletin No. 913 provides a brief resume of Pangborn dust control equipment and its place in the foundry industry. Described are cloth screen collectors, cloth bag collectors, centrifugal collectors, unit type collectors, portable unit type collectors, exhausters and blowers and dust wetters. Each unit is illustrated. Concluding the four-page folder is a description of the Pangborn Engineering Service, offering aid to foundrymen in selecting the right type of dust control equipment for their foundries.



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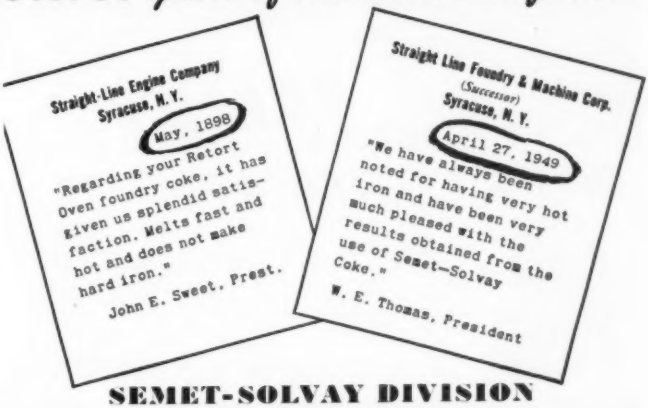
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PERSONALITIES

(Continued from Page 86)

to joining Dussault in 1931, Mr. Bertrand was an accountant and bank official.

Liston T. Lange, 53, vice-president and partner in Ferguson and Lange Foundries, Inc., Chicago, died of a heart attack recently in a Chicago hotel.

Anton Johnson, works manager of Oklahoma Steel Castings Co., Inc., Tulsa, died September 6. Long prominent in A.F.S. Committee work, Mr. Johnson was a member of the Steel Division's Executive Committee and a member of the 1948 A.F.S. Nominating Committee. Mr. Johnson began his foundry career as a molder with American Steel Foundries, Indiana Harbor, Ind., in 1911, and was successively employed by the Prime Steel Castings Co., the National Brake & Electric Co., and the Sivyer Steel Casting Co., all of Milwaukee, prior to becoming works manager for the Oklahoma Steel Castings Co.

Fred L. Wolf, 64, retired, a former Director of the American Foundrymen's Society and an A.F.S. John A. Penton Gold Medalist (1941), died September 27 in Ann Arbor, Mich. Born in Elmore, Ohio, in 1885, Mr. Wolf graduated from the University of Michigan in 1908 with a B.S. in Metallurgical Engineering. In 1911 he joined the Ohio Brass Co., Mansfield, as chemist, later becoming chemical superintendent and chief engineer. In 1942, Mr. Wolf was appointed Chief of Graphite Section, War Production Board, and in 1943 was made special investigator for the Technical Industrial Intelligence Committee. Mr. Wolf retired in 1945 following a trip to Germany and England, where he surveyed non-ferrous and malleable iron foundries. Prominent in the affairs of metals technical societies for many years, Mr. Wolf had served on many A.F.S. technical committees prior to his retirement in 1945.

Irish Ironfounders Elect New Officers, Committeemen

NEWLY-ELECTED officers and committeemen of the Irish Ironfounders' Association (until recently the Ironfounders' Association of Eire) are as follows:

Chairman—S. W. Aitkin, Hammond Lane Ironfounders, Dublin; *vice-chairmen*—Colonel H. J. Hosie, Industrial Vehicles, Ltd., Athy Kildare, and P.E.W. Burgess, Western Iron Co., Ltd., Sligo.

Committee members: G. J. Rowe, Hammond Lane Ironfounders, Dublin; P. J. Lawless, Wexford Engineering Co., Wexford; J. C. Tonge, Tonge & Taggart, Ltd., Dublin; William McBride, Wm. McBride & Sons, Ltd., Cork; A. Brown, Brown's Foundry, Letterkenny; G. Taylor and A. R. Cullinan.

An invitation has been extended by Chairman Aitken to all members of the American Foundrymen's Society visiting Ireland to contact any of the above-mentioned officers or committee members, who will be pleased to facilitate the planning of visits to Irish foundries.

BOOK REVIEWS

Mathematics

Mathematics at Work, by Holbrook L. Horton. 728 pp. 196 drawings and diagrams. Published by Industrial Press, 148 Lafayette St., New York 13. $6.00. (1949).

A working manual intended for engineers, designers, draftsmen and students, *Mathematics at Work* illustrates practical applications of arithmetic, algebra, geometry, trigonometry and logarithms by using a variety of problems taken from actual practice. Problems are analyzed and solved in an easy-to-follow, step-by-step procedure, and are grouped by common mathematical procedures. A reference section of five chapters provides a review of mathematical fundamentals, and includes a chapter on refresher questions in mathematics, mechanics and strength of materials. Concluding the book are 145 pages of standard mathematical tables.

Product Development

Developing and Selling New Products—A Guidebook for Manufacturers, by Gustav A. Larson. 75 pp. illustrated with photographs, charts and maps. Published by United States Department of Commerce. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. $0.25.

This study is based on new product case studies involving some 100 manufacturers, market research organizations and advertising agencies, and describes ideas that have proved successful in developing new products and marketing them.

Steel Heat Treatment

Steel and Its Heat Treatment, Vol. III—Engineering and Special Purpose Steels, by D. K. Bullens and the metallurgical staff of Battelle Memorial Institute. 600 pp. Published by John Wiley & Sons, Inc., New York. $7.50. (1949).

Now in its fifth edition, Volume III lists

WANTED
VOLUME 56 (1948) TRANSACTIONS

Due to an unprecedented demand, there are no more copies of Volume 56 (1948), A.F.S. Transactions for sale, either cloth or paper-bound.

Members who have no further use for their copies of Volume 56 or of Volume 48 (1940) A.F.S. Transactions are urged to write The Secretary, American Foundrymen's Society, 222 West Adams St., Chicago 6.

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fundamental principles and important factors in the heat treatment of alloy or special steels. Carbon, mild, alloy, N.E., S.A.E., and tool steels are discussed. The effect of heat treatment on the suitability of these steels for different uses and the possibilities of using alternate steels are analyzed. The book is presented in three sections: (1) Engineering Alloy Steels; (2) Constructional Alloy Steels for Heat Treating; and (3) Special Steels.

Welding Metallurgy

Welding Metallurgy, by O. H. Henry and G. E. Claussen, and revised by G. E. Linnert. 505 pp, second edition, indexed, Illustrated. Published by American Welding Society, 33 West 39th St., New York 18. $2.50. (1949).

This revised edition includes information on new processes introduced since publication of the first edition, eight years ago, such as inert-gas-metal-arc welding, and new developments in the metallurgy of stainless, heat resisting and stainless clad steels. An extensive index, a short bibliography and 150 pages of text, have been added and the number of illustrations increased to 203. Fundamentals are discussed in the first chapters for those who have little knowledge of metallurgy. The welding metallurgy of specific materials and the effect of different elements is discussed in later chapters. Questions on each chapter are provided at the end of the book for use in schools or for home study.

Spanish Molding Sand Handbook

Tierras de Moldeo (Molding Sands), by J. Navarro Alcacer. Second Edition. Printed in Spanish by Editorial Tecnos, S.A., Madrid, Spain. 114 pp. (1949).

Written by the chief of the foundry section of the Iron and Steel Institute of Spain, this volume is a discussion of molding sands and their properties and is based upon research undertaken at Spain's Iron and Steel Institute and upon articles appearing in the literature including A.F.S. TRANSACTIONS and TESTING AND GRADING OF FOUNDRY SANDS. This volume contains photographs, charts and diagrams illustrating the properties of foundry molding sands found in Spain, the United States, Germany, England and France. Chapters include information on physical-chemical constituents of silica sand; physical and mechanical properties of foundry sands; grain size determination of sands; and a study of the permeability and other properties of sands found in Spain.

Canadian Foundries

The Foundry Industry. 93 pp. Published by Canadian Founders and Metal Trades Association, Inc., 21 King St., East, Toronto 1, Ont., Canada. $2.50. (1948).

Compiled from monthly bulletins of the Canadian Founders and Metal Trades Association, this volume contains items of general interest to Canadian foundrymen and covers all phases of the industry. Gleaned from such sources as trade and technical magazines, foundrymen's speeches, noted quotations, etc., the items

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AMERICAN FOUNDRYMEN'S SOCIETY

222 W. Adams St., Chicago 6

deal with such varied topics as foundry morale, the future of the industry, youth and the industry, foundry costs, and the foundry industry's part in Canada's welfare.

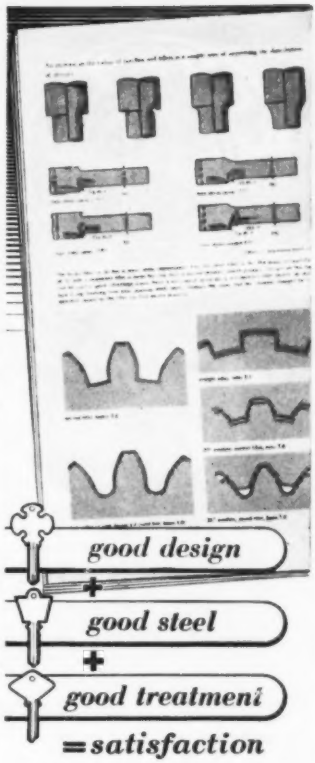
Commodities

Commodity Year Book 1949. 472 pp. Published by the Commodity Research Bureau, Inc., 82 Beaver St., New York 5. $10.00.

The 10th edition of the Commodity Year Book contains authoritative statistics on prices, supplies and consumption for the basic raw materials of industry and commerce. Derived from official and semi-official sources, such as Government agencies, trade associations, etc., is essential economic information on 85 basic commodities; statistical tables showing consumption, records and supplies; charts showing commodity price histories at a glance; and facts about sources of supply, commodity uses, Government influences, and price motivating influences. Special feature studies in the 1949 edition include advantages and pitfalls in hedging operations; economical and efficient methods for transporting specific commodities; an analysis of price support programs and parity prices; and an expanded section on weights, measures and conversion factors.

STATEMENT OF OWNERSHIP

Statement of the ownership, management, circulation, etc., required by the acts of Congress of August 24, 1912, March 3, 1933, and July 2, 1946, of AMERICAN FOUNDRYMAN, American Foundrymen's Society, published monthly at Chicago, Ill., for October 1, 1949. State of Illinois, County of Cook, ss. Before me, a notary public in and for the state and county aforesaid, personally appeared Herbert F. Scobie, who, having been duly sworn according to law, deposes and says that he is the Editor of the AMERICAN FOUNDRYMAN, American Foundrymen's Society, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, and July 2, 1946, embodied in section 537, Postal Laws and Regulations, to-wit: 1—That the names and addresses of the publisher, editor, managing editor, and business manager, are: Publisher, American Foundrymen's Society, Inc., Chicago, Ill.; Editor, Herbert F. Scobie, Chicago, Ill.; Managing Editor, none; Business Manager, Wm. W. Maloney, Chicago, Ill. 2—That the owner is American Foundrymen's Society, Inc., not for profit; stock none. Principal Officers: President, E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md.; Vice-President, W. L. Woody, National Malleable & Steel Castings Co., Cleveland; Secretary-Treasurer, Wm. W. Maloney, Chicago, Ill. 3—That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: none. 4—That the two paragraphs next above, giving the names of the owners, stockholders, and the security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholder's and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Herbert F. Scobie, editor. Sworn to and subscribed before me this 1st day of October, 1949. (Seal). C. L. Reilly, notary public. (My commission expires March, 1952).



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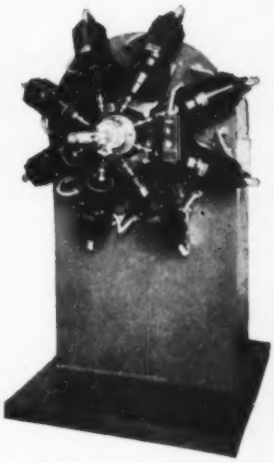

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To contact firms seeking personnel through "Help Wanted" items write to American Foundrymen's Society, 222 West Adams St., Chicago 6, designating Item Number and issue of AMERICAN FOUNDRYMAN in which published. A.F.S. Applicant Registration Form then will be sent to applicant for filling in and returning to A.F.S. Headquarters. The form will then be sent by Headquarters to the firm.

All negotiations thereafter will be carried on directly between applicant and firm. Firms wishing to contact "Positions Wanted" applicants will be furnished with applicant's qualifications, name, etc., upon request.

HELP WANTED

HW512—Working Foreman. Age 32-40. Experienced in non-ferrous melting, sand control, loose work molding and coremaking, for bench molding and shop supervision in small Midwest non-ferrous foundry. Write, giving experience and salary desired.

POSITIONS WANTED

PW119—Sales/Production: Recent metallurgical engineering graduate from large Midwestern university. Veteran, 26, married, two children. Have a little gray iron experience. Desire start in sales or production that will lead to responsible position in company that promotes from within. Available now.

PW120—Manager/Gen. Superintendent. Top flight gray iron foundry manager or general superintendent. Thirty years' experience in production, rigging, plant layout and methods, research work, inventions and modernization. Ten years' experience with Meehanite metal, sales, customer contact, design and engineering. Available only to progressive foundry, light or heavy castings in gray iron or high physical property metals.

PW121—Foundry Metallurgist. B. S. degree in metallurgical engineering. Seven years' experience in development work and foundry production problems. Desires position in foundry production and control. Familiar with cast iron, steel and non-ferrous foundry work, heat treating and testing. Some sand and core testing experience.

FOR SALE—Lindberg Type SF Stationary gas-fired furnace with silicon carbide lining and heavy insulation. Burner has proportional mixer and control for low-pressure gas. Accommodates #80 crucible. Contact Puchasing Agent, Apparatus Dept., General Electric Co., Main and Woodlawn Aves., Elmira, N. Y.

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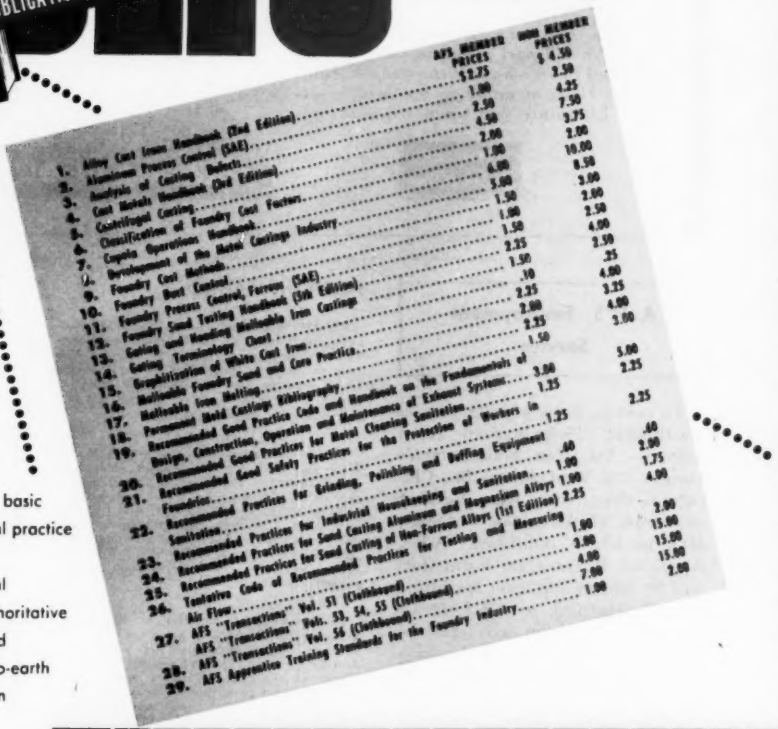

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1.	Alloy Cast Irons Handbook (2nd Edition)	$12.75	$ 4.50
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3.	Analysis of Casting Defects	2.50	4.25
4.	Cast Metals Handbook (3rd Edition)	4.50	7.50
5.	Centrifugal Casting	2.00	3.75
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7.	Cupola Operations Handbook	6.00	10.00
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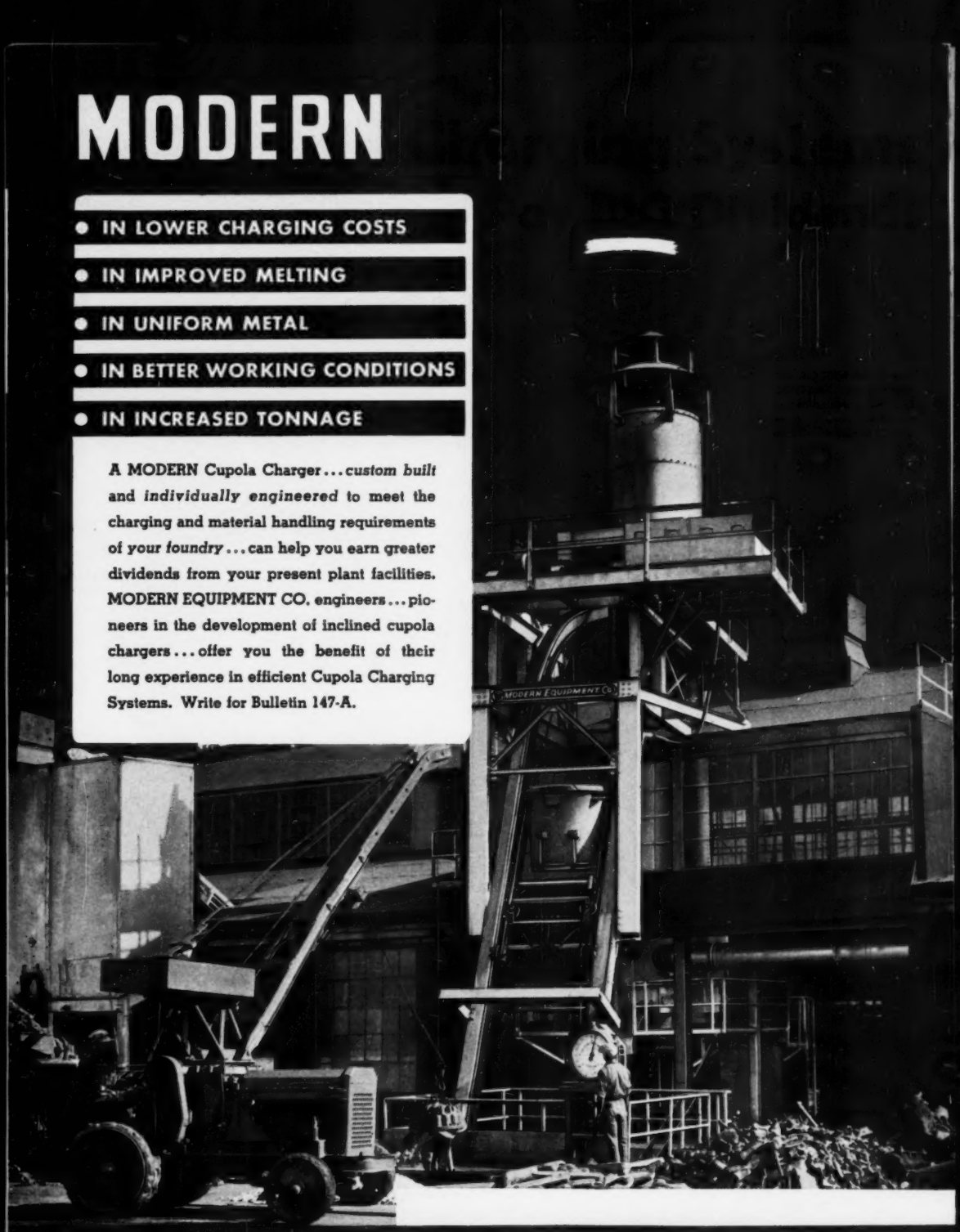

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